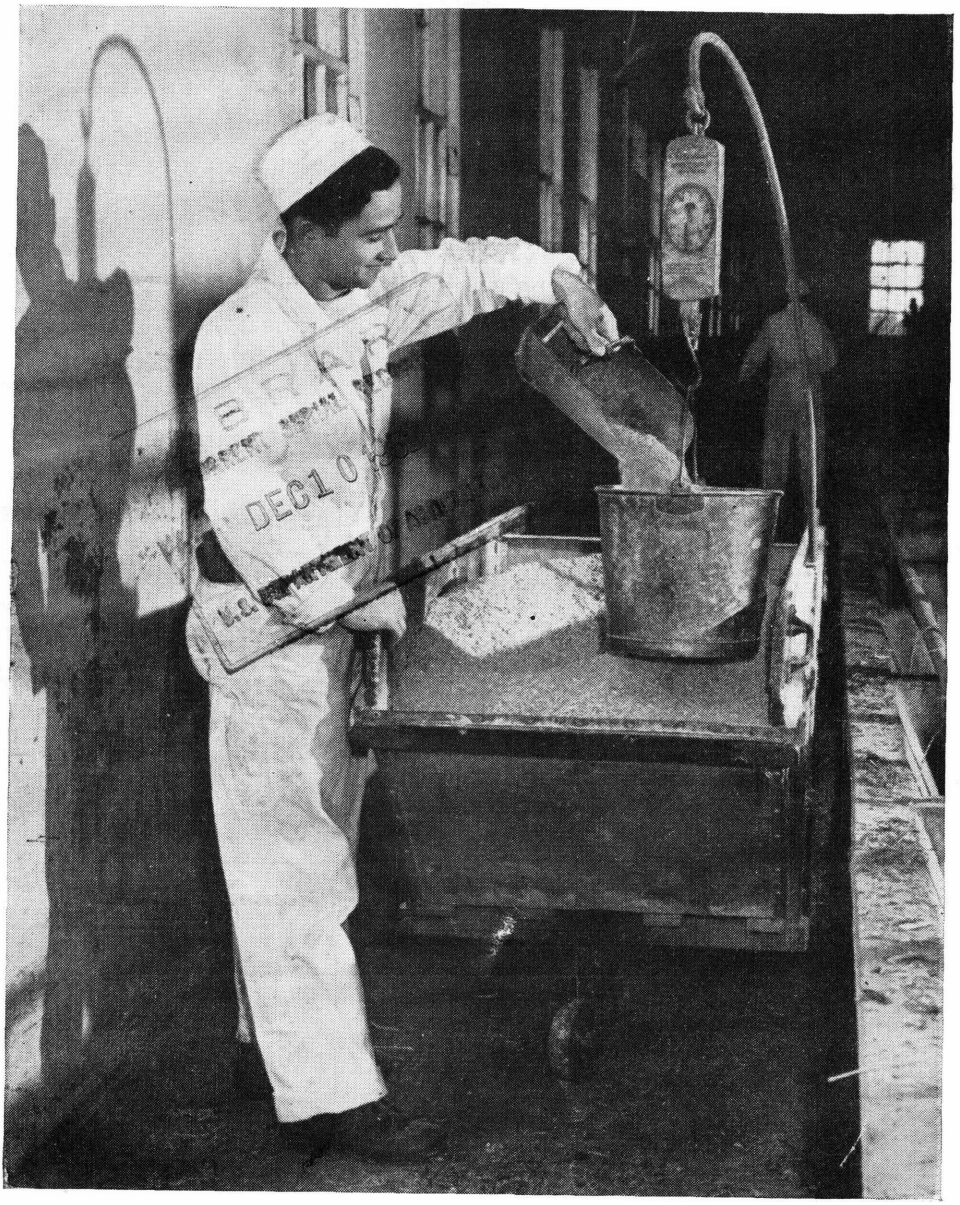
BETTER FEEDING OF LIVESTOCK



FARMERS' BULLETIN NO. 2052

U. S. DEPARTMENT OF AGRICULTURE

Ten Points in Better Feeding

1. Growing animals make best use of feed; keep them growing.
2. Weaning time is a critical period; start feeding before weaning.
3. Balanced rations supply animals' needs with least feed.
4. Water and salt should always be accessible.
5. Legumes, pastures, and succulent feeds aid production and profit.
6. Feed liberally for large production; mere maintenance yields no profit.
7. Breeding animals should be kept thrifty, but not overfat.
8. Good feeding equipment prevents waste of feed and labor.
9. Parasites, exposure, and overcrowding retard growth and waste feed.
10. Feed costs are important; not all balanced rations yield equal profit.

This bulletin is a revision of and supersedes Miscellaneous Circular 12, A Handbook for Better Feeding of Livestock.

Washington, D. C. August 1952

Better Feeding of Livestock

By *specialists of the Bureau of Animal Industry and of the Bureau of Dairy Industry, Agricultural Research Administration.*

Contents

ANIMALS AND ANIMAL PRODUCTS account for more than half the gross farm income in the United States. This fact emphasizes the great importance of efficient and economical feeding in profitable farming. Careful consideration of feeding problems and calculation of costs to improve efficiency of production are principal elements in good management of livestock. Good management also calls for keeping up-to-date and putting to use new information on animal breeding and feeding as it is developed by scientific research.

Management as an Aid in Feeding

Selection of Stock

The selection or breeding of animals to be fed is the first consideration. Results obtained from feeding will depend in large measure on the health and individual characteristics of the animals. The best feeders are strong and healthy, with quiet dispositions and from good breeding stock. Sleek hair and bright eyes are indications of general thriftiness and efficiency. Good teeth are of prime importance.

Select animals that are adapted to the purpose for which they are to be fed. A dairy cow cannot be expected to produce choice beef; a beef cow usually gives comparatively little milk. Purebreds of good type bring greater returns than scrubs or common stock. Crossbreds and grade stock of good breeding also generally give excellent results from a utility standpoint.

Animals, even those of the finest breeding and given the best feeds in correct proportions, do not make a profit unless they are properly cared for and kept in good health. Disease, lice, worms, and various discomforts are responsible for waste of feed. Carefully examine any animal that remains in poor condition after it has been properly fed and remove the cause of the trouble.

Attention to Details

Persistent attention to details that may seem unimportant pays well in the end. Not only maintenance of the animals' health and comfort, but also consideration of their individual likes and temperaments, makes for success in feeding.

Keep animals from wasting energy through unnecessary muscular activity. Rough treatment, excitement, and noise can result in inefficient use of feed. Permit fattening animals and milking cows to exercise no more than is necessary for their health. Dehorning is often desirable to prevent injury from fighting among animals. Castrate males that are to be fattened. They will be much quieter, produce better quality meat, and bring a higher price.

Sanitation

Labor used to keep the feed lot, shelters, and equipment clean and sanitary is well spent. Sanitation often prevents losses from disease and digestive disturbances. The feed lot should be large enough to prevent insanitary muddiness, or small enough to be paved. Clean the shelters regularly. Some animals refuse to eat soiled food. Contaminated feed or water may cause or spread disease.

Feeding Equipment

Proper equipment, well arranged, saves feed and labor. Keep grain and similar feeds in ratproof and mouseproof cribs or bins. These rodents eat large quantities and waste still more.

Labor-saving devices, such as self-feeders and racks, are economical.

Where large numbers of livestock are fed it is ordinarily advisable to use a truck or an overhead carrier from the feed room or bin to the feed troughs or bunks. Silage may be fed in the same way.

Chutes from the haymow into or near the mangers save labor.

Self-feeders (p. 26) are most useful in fattening hogs for market and in feeding chickens. They are great labor savers and are especially valuable when there is much farm work to do, for they can be filled at odd times so that field work can go ahead with less interruption.

Give young growing animals additional feed in creeps or pens adjacent to the pens or pastures in which they run with their dams. The creeps are so constructed that the old animals cannot enter them (fig. 1). Size of opening should be regulated by both width and height.

Feeding equipment, especially for young animals, should be kept clean. If animals are given more feed in their boxes or troughs than they will consume before the next feeding, this stale feed, if left, will be wasted and will also cause part of the new feed to be wasted.

Pails for feeding calves, bottles and rubber nipples for feeding orphans, and other feeding utensils, if allowed to become dirty, may cause serious digestive troubles or permanent disease. Thorough cleaning and sterilization of the equipment will prevent this.

Care in Feeding

Supply each animal according to its needs. The safest way to do this properly is to have some means of measuring or weighing the feed. In using concentrated feed the quantity to be given at each feeding may be easily calculated by determining the weight

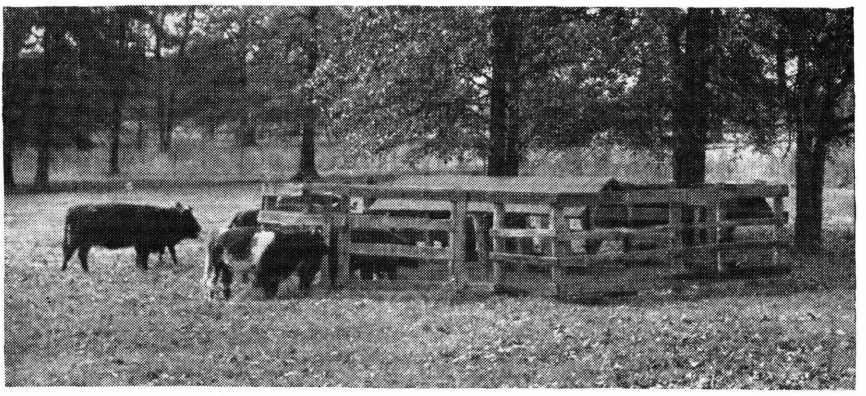


Figure 1.—Calves are fed their grain rations in an enclosure with an entrance too small to admit grown animals.

of the contents of a measure (p. 49). Hay that has been baled may be weighed easily, but in using loose hay the weight of an average forkful should be determined.

Underfeeding

Farm animals that are underfed cannot produce economically with the feed given them. A ration which supplies only an animal's maintenance requirements does not allow for the needs of growth, work, fattening, or the production of milk, eggs, or wool. Using unbalanced rations is a form of underfeeding, for the animal will not thrive or produce profitably, even though the ration is plentiful. Animals have nutritive reserves upon which they can draw during periods of restricted feed intake. Such conditions exist often among wild animals and in domestic animals on the range, especially in winter or during drought.

Restricted feeding may be considered to be one form of underfeeding as compared to full feeding. Total returns from animal feeding are sometimes greater when the animals are fed somewhat less than they need for maximum production. The fatness of the animal can be controlled by regulating the quantity of feed. For reasons of economy, breeding animals are usually not fed to capacity. Furthermore, animals that are too fat do not breed so readily as those in normal condition or even underweight.

Overfeeding

Overfeeding is wasteful in several ways. Overfed animals may eat more than they can digest and leave in their troughs feed which they will not eat later. They may also suffer from digestive disturbances that result in loss of weight and, with lactating animals, in a reduction of milk flow. Animals having mild digestive troubles are commonly referred to as being "off feed." Overfeeding also results in less efficient utilization of the nutrients consumed.

As a rule, old animals are more wastefully fed than younger ones. It is best to keep animals ready for a little more feed than they have been given. Carefully controlled feeding just below the maximum an animal will readily consume is more effective than alternate periods of gorging and off feed.

Regular Feeding

A little attention to details in feeding and caring for animals sometimes counts for a great deal. Regularity of feeding usually repays the feeder for the added trouble.

Number of Feeds a Day

Horses at work and dairy cows producing heavily should be fed three times a day. Animals under 6 months of age should be fed at least three times a day, and the intervals between feeds should be as nearly equal as possible. Two feeds a day for other animals are usually sufficient. In fattening steers, satisfactory results are commonly obtained with one feed of concentrates a day, especially when the steers are on pasture or receive a ration containing considerable roughage.

Abrupt Changes in Feeds

Sudden changes in the diet may throw an animal off feed. Although changes are often necessary, the new feeds should be begun a little at a time. In like manner, when some feed is to be omitted from the diet make the change gradually.

In dry-lot or stall feeding, it is a good rule to take several days to change from one important ingredient to another. Reduce the feed being taken out about one-fourth the first day, one-half the second day, and so on, adding an equal quantity of the new feed each day. In turning animals out to pasture or changing pastures, make the change gradually. First, be sure the animals have had their fill of hay or of the old pasture; then begin with an hour's grazing on the new pasture after the grass is dry, gradually increasing the time on the new pasture during succeeding days.

Harvesting Crops With Livestock

Crops may be harvested by livestock economically when the value of the feed lost through trampling by the animals does not exceed the cost of harvesting in the usual manner. When the field being harvested by stock becomes muddy, the animals should be moved to a well-sodded pasture or dry lot and fed by hand. Harvesting with livestock is most common with corn alone, or with corn and soybeans, cowpeas, or velvetbeans. Poor stands of the small grains also may be advantageously harvested in this way. Animals to be fattened by this method should be turned into the field first and later, when the crop is nearly harvested, replaced by other stock to clean up what the fattened stock have left.

It is often good practice to harvest the best part of a crop before stock are turned in to harvest the remainder.

Special Precautions in Feeding

Feeding on Dead Animals

Feeding livestock the carcasses of animals that have died of disease is a common source of infection of healthy stock. Experiments show that hogs may contract tuberculosis by killing and eating chickens that have that disease and are too weak to escape being caught.

The safest way to dispose of dead animals is to burn them to ashes. Another good way is to place them in a deep hole or pit and cover them first with quicklime and then with several feet of earth. If a carcass is left on the ground, birds, dogs, and other animals may feed on it and spread disease and parasites over a wide area.

Poisoning From Plants and Feeds

Plants which are injurious to domestic animals are found in all parts of the United States, but are most destructive on the western ranges. Larkspur, whorled milkweed, and locoweed are among the most destructive. Animals should be kept away from areas where such plants are known to grow, especially when the pasturage is short. (Bulletins describing these plants and giving methods of treating poisoned animals may be obtained from the United States Department of Agriculture.)

In certain sections of the West, some soils contain the element selenium, and plants grown on these soils may contain it in sufficient quantities to be toxic when consumed by animals. All species of livestock are affected. Serious losses may result from the use of feeds containing selenium.

Heavy fertilization of pastures with phosphate fertilizers high in fluorine may result in stock poisoning. The fluorine softens the teeth, injures the bones, and retards normal growth, fattening, and reproduction.

Bloating

To reduce the danger of bloating, cattle and sheep should be given a good fill of dry feed, particularly roughage, before they are turned on green forage, such as red clover or alfalfa. If some dry roughage is convenient for them in the pasture, they often correct of their own accord any tendency to bloat. The danger of bloating is generally increased by dew or rain on the pasture.

Horses and hogs are not subject to bloating, but before being turned out on green forage for any length of time they should be gradually accustomed to the change. Frequent observations of animals on pasture that is likely to cause bloat are necessary to prevent losses from bloating.

Feed Requirements of Livestock

Feed consumed by livestock is used for different purposes, depending to some extent on the character of the animal. All animals use a certain part of their feed to maintain their bodily functions. In addition, animals use feed to take care of the functions for which they are kept. Young animals need nutrients to build flesh and bone in growth; breeding females require feed for the development of their young; work animals use feed to supply energy for productive work; fattening animals need additional feed for the formation of flesh and fat. Other animals require feed for the production of milk, eggs, and wool.

To supply all these needs livestock must receive enough feed to furnish the necessary proteins, carbohydrates, fats, minerals, and vitamins. Special consideration must be given to certain of the nutrients and to other characteristics of a satisfactory diet.

The percentage composition of the principal feedstuffs used in animal feeding are given in table 2, page 53.

Proteins

Growing animals require an abundant supply of protein. There are two kinds of proteins—those of plant origin and those of animal origin. Proteins of plant origin are low or lacking in certain essential substances which are contained in animal proteins. In feeding hogs and chickens, proteins of animal origin may be used to supplement those from corn, barley, and other grains, as these animals require proteins that are not contained in plants. Mature cattle, sheep, and horses need a liberal supply of legumes, as hay or pasture, with a supplement of concentrates. They do not require feed of animal origin. To make sure that a diet has the proper kind of protein for animals that do not ruminate it is well to include a variety of feeds.

Urea

Urea as manufactured for feeding livestock contains a high percentage of nitrogen—approximately 42 percent. This may be expressed as equivalent to 262 percent protein. This compound may replace part of the protein in the ration for ruminants. When urea is fed with feeds containing readily available carbohydrates, the urea nitrogen is utilized by micro-organisms in the rumen of cattle, sheep, and goats to build up protein in bacterial cells. As the bacteria die, the cell proteins are digested and utilized by the animal.

Because of the high nitrogen content, 1 pound of urea is roughly equal in terms of protein to 6.4 pounds of an oil meal having 41 percent of protein. This means that very small quantities will supply the required level of protein equivalent. Generally, 1 to 3 percent by weight of the total dry ration is sufficient. There are limits beyond which it is considered unsafe to go because of possible toxic effect. The main consideration is thorough and uniform mixing of the urea into the grain or feed mixture. The small amount of urea which has to be added to grain to raise its protein content to meet basic nutritional requirements should not be harmful if the feeds are properly blended. Because of the necessity of proper blending, purchase of mixtures containing urea is favored.

Mineral Elements

An adequate supply of minerals in the diet is of greatest importance in the case of young growing animals and of females carrying or suckling young. Minerals are necessary also for animals of all ages and conditions. Mineral matter not only makes up a large part of the skeleton; it also aids in the functioning of all parts of the body.

Bone chewing and other forms of depraved appetite are often indications of a lack of minerals in the diet. Common salt, calcium, phosphorus, and iodine are most often lacking.

Salt should be accessible to farm animals at all times, no matter what other feeds they receive. A mineral mixture containing salt should be available to hogs at all times. It may be incorporated in

the ration or placed in boxes or self-feeders where it will be dry. For poultry, it is best to mix the salt with the concentrates fed.

Diets made up largely of straw, roots, and the cereal grains and their byproducts may be deficient in calcium. Whole milk, skim milk, and buttermilk contain plenty of calcium; legume hays exceed all other farm-grown feeds in content of this element. Calcium in the form of ground limestone, oystershell, calcium phosphate, or bone meal may be added to a diet if the element is lacking.

Diets that contain enough protein usually contain plenty of phosphorus, especially if a high-protein concentrate is one of the ingredients. Legumes, grasses, straws, beet pulp, potatoes, and molasses contain but little phosphorus. It may be added to a diet, together with calcium, in ground bone or one of the calcium phosphates. The continued use of raw rock phosphate containing too much fluorine is detrimental to the health of animals. Defluorinated phosphates, however, are satisfactory.

One satisfactory method of feeding minerals, if they are needed, is in combination with common salt. Mixtures of three general types are used for cattle, horses, sheep, and hogs, depending on the feeds with which they are to be used:

(1) With diets containing sufficient phosphorus, use 2 parts of ground limestone to 1 part of common salt.

(2) With diets requiring both calcium and phosphorus, use 2 parts of steamed bone meal and 1 part of salt.

(3) With diets requiring more calcium than phosphorus, use equal parts of finely ground limestone, steamed bone meal, and salt. This mixture is especially suitable for hogs.

Iodine Deficiencies

In parts of the Northwestern and North Central States farmers have lost many newborn colts, calves, lambs, and pigs from goiter. The young are born weak or dead, and are often hairless or have enlarged necks. This condition is due to a lack of iodine in the dam's diet. The difficulty may be prevented by giving the pregnant animals potassium iodide in very small quantities.

Iodine deficiency is easily corrected by substituting stabilized iodized salt for common salt in the regular mineral or feed mixtures. Iodine should not be added to the diet unless needed; an excess may overstimulate the thyroid gland.

Mineral Deficiencies

A number of complex mineral mixtures designed to furnish all the mineral requirements of the different classes of livestock are on the market. None, however, will satisfy all sorts of feeding conditions. In using a complex mineral mixture, there is danger that some of the elements may be supplied to the animals in excess and others in insufficient amounts to do any good. In case of suspected mineral deficiencies, consult the county agent or State agricultural college, or the United States Department of Agriculture, to determine how best to handle the situation. Calcium and phosphorus are usually the most important minerals to consider (table 2).

Mineral elements besides salt, calcium, phosphorus, and iodine, necessary to animal health are cobalt, copper, iron, magnesium,

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manganese, potassium, and sulfur. Feed crops grown in certain areas are deficient in cobalt and copper; addition of these and some minor elements is advisable for certain classes of livestock—for example, iron and copper for hogs and manganese for poultry. Quantities and methods of supplying these additions are given in the sections dealing with the various classes of animals.

Vitamins

Feeding experiments have demonstrated that small quantities of vitamins must be present in the diet in order that animals may live and grow properly. The absence of any of them from the diet may lead to failure in growth and to characteristic disorders, usually called deficiency disease. Different species of animals vary in their needs for vitamins and not all suffer from the same deficiency diseases.

Under practical conditions, the diets of farm animals usually contain adequate quantities of the vitamins. However, when there are deficiencies, they are most likely to be in vitamins A, D, or B_2 (riboflavin). In droughts or other conditions of restriction in diet, difficulties may arise especially in such high-producing animals as poultry and dairy cattle. Such animals may be given a diet which contains too high a proportion of manufactured byproducts and thus receive too little of one or more of the vitamins.

It is advisable to have a plentiful supply of the various vitamins in the diet of animals that supply food for human consumption. It is possible to increase the content of certain vitamins in such products as milk and eggs by liberal feeding of those vitamins.

A supply of vitamin A is important in feeding livestock of all classes. Good pastures, silages, green leafy hays, and yellow corn are the principal sources of carotene, from which animals are able to form vitamin A. If such feeds are low or lacking in the diet, animals may suffer from disease and fail to grow properly. Where it is impossible to feed yellow corn or good-quality roughages, such as hay and silage, vitamin A may be added to the diet by feeding fish oils, which are high in that substance, or by using vitamin A concentrates.

The best means of insuring an adequate supply of vitamin D is to expose livestock to direct sunlight. Growing animals confined indoors for long periods, or those in northern regions during the winter, may develop rickets due to a lack of vitamin D. Most farm-grown feedstuffs are relatively low in this vitamin. Sun-cured hays are richer in vitamin D but lower in carotene, or vitamin A, than hays cured artificially. Vitamin D may be added to the diet by feeding high-potency fish oil or activated animal sterol.

The usual diets of livestock, which include green forage, high-quality legume hay or alfalfa leaf meal, grains, grain byproducts, and animal protein concentrates, supply all the riboflavin needed for growth and reproduction. Poultry diets should provide an adequate supply of riboflavin. Swine require riboflavin, which is seldom lacking in the average diet, except perhaps in the diets of sows during gestation and lactation. Diets which are too low in riboflavin may be corrected by including a dried-milk product, alfalfa leaf meal, or yeast. Among the other vitamins required by swine are nicotinic acid, pantothenic acid, and thiamine (vitamin B_1). Unfortunately, corn is rather low in nicotinic acid and pan-

tothenic acid, and pigs may receive inadequate amounts if the supplemental feeds are limited in quantity and variety. However, the thiamine supply is not likely to be inadequate in the common hog rations based on whole grains and mill feeds.

A recently discovered vitamin—vitamin B_{12}—is required by both poultry and swine. Feeds of plant origin are generally low in this vitamin, but those of animal origin usually contain reasonably adequate amounts.

In general, the other vitamins so far discovered are supplied in adequate quantities in livestock diets. However, if obscure troubles which are suspected of being due to vitamin deficiency arise, the county agent or the State agricultural college should be consulted.

Antibiotics

Antibiotics may be considered as organic compounds, with germ-killing properties, that are used in the field of medicine for combating disease. Their growth-promoting effects when fed to livestock were recognized by chance. The discovery that the microorganisms used in the production of certain antibiotics also produced substantial quantities of vitamin B_{12} led to the use of antibiotic fermentation residues as vitamin B_{12} supplements for poultry and swine feed. Subsequent investigations established that growth stimulation above that obtained from vitamin B_{12} was due to the antibiotic content of the residues. Although considerable information on which to base practical recommendations is available, research into the basic facts on the feeding of antibiotics to livestock and the manner in which they exert their effects has just begun. Every day new facts are being discovered which may modify our present knowledge and make present practices obsolete.

Reports to date show that under certain conditions penicillin, aureomycin, bacitracin, terramycin, and streptomycin stimulate the growth of swine and poultry. Some antibiotics have proved ineffective or only moderately effective and still others remain to be tested. Some antibiotics must be fed at relatively high levels to achieve optimum growth responses and are impractical for economic reasons. Effectiveness of a given antibiotic may vary with the animal species. For example, an antibiotic may stimulate growth of poultry but be relatively ineffective with swine, or vice versa. However, some antibiotics seem equally effective for swine and poultry. The growth-stimulating effect appears to be proportional to the age of the animal, being greatest with the newborn and decreasing with age. The value of antibiotic feeding may be influenced by the degree of viral and bacterial infection present, as evidenced by the marked response of runts and unthrifty pigs to antibiotic supplementation.

Water Supply

The water consumed by animals aids in the mastication, digestion, absorption, and transportation of foods within the body. It helps maintain the vital functions of the various organs and regulate body temperature. Necessarily, therefore, an adequate supply of fresh, pure water is essential (fig. 2). It is best, so far as possible, to have water readily available at all times, especially for animals on pasture. If the animals have to go too far to obtain

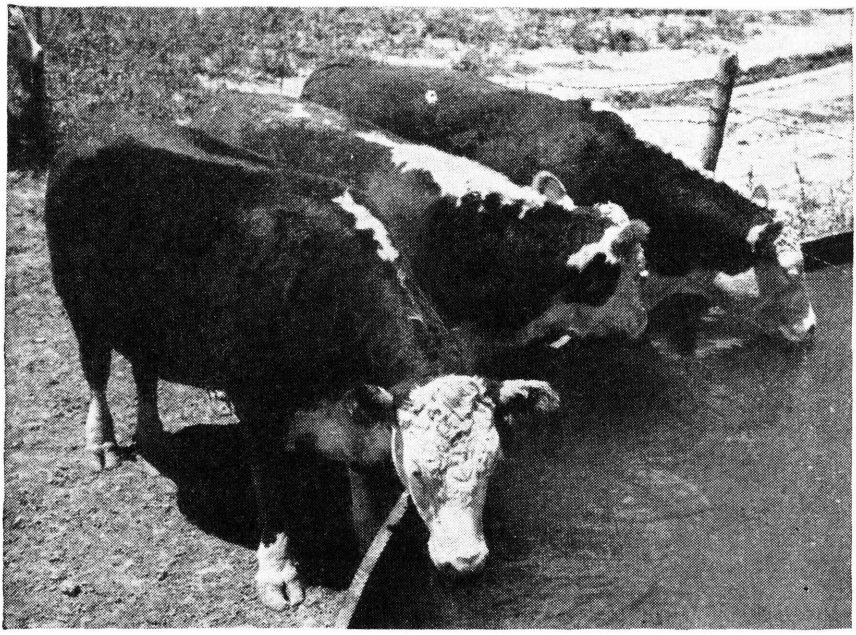

Figure 2.—Two-year-old steers drink from an abundant supply of clean well water in a galvanized tank.

water, they often will not take the trouble and therefore, will not drink enough to meet their needs. In cold weather, if the water is cold, animals may not drink enough. Then the water should be warmed slightly or the animals should have the opportunity to drink more frequently.

Animals need more water in hot weather than at other times, especially horses at hard work. The animals then should be given more frequent opportunities to drink. Horses that are warm from working, however, should not be allowed to drink all they want until they have cooled off.

The stockman should be sure that his water supply is uncontaminated at its source, and then make it available to his animals in troughs or other equipment which are always kept clean. By not allowing animals to drink from stagnant pools and contaminated streams, the introduction and spread of disease through the water supply may be prevented.

The water which animals drink requires heat to warm it to body temperature. This process utilizes heat energy derived from the feed consumed. Under most conditions the excess heat produced by normal bodily activity of the animal is sufficient to warm the water consumed and no energy is wasted in the process. Only under conditions of extreme cold or when on low levels of feed consumption do animals need additional feed to warm the water which they drink or to have the water warmed for them.

Additional Requirements of a Good Diet

To obtain best results in feeding, supply feed that is palatable to the animals, especially high-producing and fattening animals,

which must consume large quantities of feed to produce satisfactory results. Animals will consume larger quantities of a diet that is palatable and in some cases may utilize it more efficiently. A diet may be improved from this standpoint by the use of succulent feeds, such as pasture, silage, or soiling crops, that also often add needed vitamins and minerals. Molasses is sometimes added to mixtures of dry feeds to make them more palatable.

Variety in feeds is important, especially for nonruminating animals. This does not mean that a diet must include a large number of feeds, but rather feeds from several different sources. An animal's needs for proteins, vitamins, and minerals can probably be better met if the diet is not too limited. The proteins of some feeds are supplemented by those of other feeds. Thus, the inclusion of proteins from animal sources, except for horses, sheep, and mature cattle, helps in making sure that a diet which otherwise contains only feeds of plant origin is satisfactory in its protein content.

In feeding enterprises, economy demands careful consideration of the feeds to be used. Use home-grown feeds so far as is practical, supplementing them with purchased feeds only to the extent necessary to furnish an adequate diet.

Forage Crops

Forage crops and other roughages, in the form of pasture, hay, silage, straw, stover, fodder, and soiling, furnish the least expensive base for the livestock ration. Certain of these feeds are often wasted except as they may improve the soil and their use in feeding animals is just that much gained. For sheep and dry beef cows the diet may be composed almost entirely of this sort of feed.

Pastures

For adequate nutrition and economy, good pasture is the outstanding livestock feed throughout as much of the year as it is available. It may serve as the only feed for some classes of cattle, for sheep, goats, horses that are not working, and for dry cows. The use of a concentrate in addition to pasture is necessary for the maximum fattening of cattle and sheep and for cows producing large quantities of milk, horses that are working, growing and fattening hogs, sows with pigs, and poultry. However, suckling lambs on lush pasture with their mothers have sometimes fattened satisfactorily and economically without supplementary grain feeding.

A good pasture should provide a combination of palatable forage plants, such as the nutritious grasses and legumes. The growth should be dense enough to furnish sufficient feed without too great effort. Good mixtures of pasture grasses which furnish grazing for maximum periods of the year are especially desirable.

Immature grass is more palatable and nutritious than mature grass. The vitamin, protein, and phosphorus contents of young grass are higher and the nutrients are more efficiently utilized than those in old grass.

Too great dependence should not be placed on pasture as a sole source of feed, however. It is difficult to maintain a uniform supply of feed throughout the pasture season. Temperature and moisture

conditions, as well as the natural growth habits of the plants, affect the quantity and value of the feed to be obtained by grazing at different times of the year. This disadvantage may be overcome to some extent by including a variety of plants in the pasture. For example, in the North bluegrass grows best in spring and fall, and may be supplemented, if not too far north, by plants like annual lespedeza, which is late starting and makes most of its growth in midsummer. In the South, legumes like white Dutch clover and bur clover, which grow best in fall, winter, or spring, may be used along with Bermuda, carpet, and Dallis grass, which make their growth in summer. In addition to a variety of plants in the pasture, supplementary pastures of such crops as the after-feed of hay fields, Sudan grass, oats, rye, wheat, sweetclover, and soybeans may be furnished to good advantage.

If the ground is so poor or so dry that only a sparse growth of pasturage is possible, it cannot be used profitably for feeding high-producing animals. The stock will not be able to cover a wide enough area to obtain sufficient feed. The growth may be so sparse that breeding stock, if pregnant, cannot gather the forage economically. In a sparse growth of forage in an arid region, the feeding value is retained so well after the plants become mature and dry that fair grazing may be possible the year round. Heavy rainfall and dew, however, leach and cause weathering of mature plants, so that many of the nutrients are lost.

Do not turn stock out on pasture before the grass is 3 or 4 inches high; the roots need a chance to develop. Do not graze a pasture too heavily; overgrazing lowers the production of forage, gives weeds a chance to grow, and may result in serious soil erosion. On the other hand, undergrazing, particularly in spring, when pasture growth is heavy, may allow the plants to mature and go to seed. Such stemmy growth is less valuable than young leafy growth. Turn enough stock on the spring pasture to keep it well grazed and furnish supplementary pasturage or other feed later, when permanent pasturage is less plentiful.

Do not graze grasses on the western ranges close enough to prevent maturity of the plants; it may kill out the best grasses. Let a large part of the vegetation mature and use it later.

Cultivated Forage Crops and Hays

Cultivated forage crops and hays have one advantage over pasture in that they usually produce more feed to the acre. This difference may be fairly large in regions with high rainfall, but it is even greater in dry areas. Such crops as hay or silage may be preserved and fed when pasturage is not available. They may also be cut green and fed as silage to supplement summer pastures.

Crops used as hay should be cut at the right stage and carefully cured to insure the most economical supply of feed. Grasses and legumes should be cut before maturity, for the greatest yield of nutrients is obtained at that stage of growth. Curing should be completed quickly with the least possible exposure to the weather. Dew or rain causes a loss of valuable nutrients. Curing in sunlight and in such manner that the natural green color is retained results in a more palatable and nutritious hay. Hay crops should also be cured so that few leaves are lost by shattering, for these parts of plants are the most valuable as feed. Barn drying with the aid of

forced ventilation is also an effective means of preserving the nutrients in hay.

Preserving crops in silos provides a succulent nutritious feed during the winter or in other periods when good pasture is not available. Silage increases the palatability of the ration, adds minerals and vitamins, and leads to the consumption of more nutrients in the form of roughage.

In case such legumes as soybeans and cowpeas cannot be made into good hay, they may be put into the silo with corn or sorghum, thereby saving the crop and improving the protein and mineral contents of the silage. A wide variety of crops may be preserved as silage, but corn is the best adapted to this purpose and is most commonly used. Crops must be placed in the silo soon after being cut, so that there will not be much loss of moisture. It is best to wilt legumes slightly before ensiling them. Wilting improves the palatability of the silage and prevents leakage from the silo, which, besides being a nuisance, is destructive to concrete and masonry work. Silage must be chopped fine, evenly distributed, and well packed to exclude air, which may cause spoilage.

Difficulties may arise in the use of high-moisture legumes and immature grasses for silage. Such crops do not contain enough carbohydrates to produce the acid required to insure that the fermentation will follow a desirable course. To overcome this lack of acid production, molasses or other high-carbohydrate material, such as ground grain, may be added to the material as it passes through the silage cutter. From 40 to 60 pounds of molasses should be added for each ton of green forage, grasses, or mature legumes. When corn meal is used, approximately 200 pounds for each ton is recommended. Another method of preserving legumes and grasses in the silo is by adding dilute mineral acids. The addition of acids prevents the growth of undesirable bacteria that causes ill-smelling silage. Both methods require more labor and the added expense must be considered before either is adopted. (Farmers' Bulletin 578, The Making and Feeding of Silage, gives further information on this subject.)

All kinds of forage or cultivated crops may be cut green and fed as soilage under conditions where such feeding is necessary to supplement pasture. The chief disadvantage is that the procedure involves extra labor, but the time spent may be well worth while for special purposes, such as maintaining milk production in late summer.

Concentrate Feeds

Working and high-producing animals need concentrate feeds in addition to roughage. Home-grown or purchased grains and commercial byproducts serve the purpose.

In general, it is most economical to use home-grown feeds in supplying the animals' needs for concentrates, or at least as the basis of the concentrate mixture. This is especially true if the roughage portion of the diet, produced on the farm, contains enough of the legumes so that the purchase of high-priced protein concentrates is unnecessary. With some classes of livestock, the cereal grains—corn, wheat, oats, or barley—may be used as the sole concentrate. On the other hand, growing and high-producing animals, especially the nonruminants, will need more variety and

better balance in the concentrate part of the ration. If the roughage available is poor in quality or low in protein, the concentrate mixture should contain a high-protein concentrate, such as cottonseed meal or linseed meal, unless the animals fed are to be carried on a diet for maintenance only. It may be more economical to sell the grains grown on the farm and buy other concentrates, but usually the purchased feeds are more expensive than equivalent feeds procured at home. In the Northeast and other regions where more intensive farming is practiced, it is often impossible to raise enough grain on the farm to supply the needed concentrates.

To meet the need for additional concentrates commercial byproducts are available in large variety. They include byproducts of the milling, brewing, and distilling industries, of the oil-bearing seeds, of the dairy industry, and of the meat packers, fisheries, and canneries. The byproduct feeds are either marketed as produced or used in proprietary feed mixtures intended to furnish ready-mixed balanced feeds for the different classes of animals. Many of these feeds are excellent and highly palatable and are sold at reasonable prices.

Practically all States have feed-control laws that require a statement of the analysis of the feed on the bag. Usually the percentages of protein, fat, nitrogen-free extract, and crude fiber are given. State agencies administering the laws publish reports and bulletins giving the State requirements for commercial feeds and the results of the analyses of samples of the feeds for sale within the State. Prospective buyers can determine which feeds are the best buys and how to interpret the statements on the tags by obtaining copies of the bulletins published in their States.

Because many of the feeds available on the farm are low in protein, the percentage of protein in a commercial feed is the most important measure of its value. Commercial feeds with high percentages of crude fiber, in general, are comparatively low in available nutrients.

Cane molasses (blackstrap) and beet molasses are chiefly carbohydrate feeds, but they have a special value in increasing the palatability and general efficiency of feeds. However, their carbohydrate content is lower than that of many grains. They may be substituted for a part of the grain if their cost is slightly less. When so used, molasses is worth about 70 percent as much as corn a pound. Almost 7 gallons is required to replace a bushel of corn. Because of its palatability, molasses often increases the consumption of feeds, especially dried roughages which are unpalatable. Its use may, therefore, increase the rate and efficiency of gains in weight. Cane molasses is mildly laxative; beet molasses more so.

In feeding molasses, it may be necessary to dilute it with 1 or 2 parts of water, so that it may be readily sprinkled on the feed. In cold weather it should be diluted with hot water. In summer it should not be so diluted; the resulting solution will ferment readily. Molasses may be fed undiluted to horses and mules in troughs or feed boxes. Fed in warm weather, molasses may stick to the feed troughs and to the hair of animals, where it will attract flies.

Yeast is a rich source of the B vitamins and also of good-quality protein. It is therefore valuable in diets. Probably the best-known

yeast product available is dried brewers' yeast. The choice between yeast and other feedstuffs to supplement a deficient diet depends on the quality and quantity of protein and the kind and quantity of vitamins in relation to the costs.

Mixed Feeds

Farmers who can produce a variety of suitable feeds may save money by mixing their own feeds. However, the value of farm grains plus the cost of grinding and mixing, as compared with the cost of commercial feeds, including freight and hauling, should determine whether it is best to mix feeds at home or buy ready-mixed feeds. Many poultry feeders, for instance, find it cheaper and less troublesome to buy ready-mixed mashes than to buy the ingredients and do their own mixing. Hogs may be given the various feeds separately and permitted to make their own choice. Mixed feeds, when properly prepared to meet the animals' needs, are highly satisfactory and may be self-fed.

Preparing Feed for Livestock

Grinding Feeds

Small, hard grains like rye, wheat, barley, rice, and kafir should always be ground or rolled when fed to livestock, for they are difficult to chew, with the result that they are not efficiently utilized. Such grains as corn and oats should be ground for very young lambs, dairy cows, and heifers, and fattening cattle when no hogs are following them. However, it may not always pay to grind corn and oats in feeding small quantities to animals that have good teeth.

Soaking and Cooking Feeds

Soaking, cooking, and steaming feeds may increase the digestibility of the starches, but usually not enough to pay for the expense and work involved. Heating sometimes decreases the digestibility of proteins appreciably. The cooking of feed sometimes encourages animals to eat more, which may be desirable when maximum gains are required. Potatoes should be cooked before they are fed, but not allowed to stand long before use because molds may develop. However, it is not necessary to cook potatoes for horses, mules, and dairy cows. Soybeans, field beans, and velvetbeans should be cooked for swine and poultry. Cooking increases the value of the beans chiefly with respect to available proteins. Soybean meal as purchased has usually been heated enough to make the product satisfactory for feeding.

Fermenting and Sprouting Feeds

Fermentation of feed mashes by the aid of added yeast is sometimes recommended as a means of increasing the feeding value of grains and roughages through the changes in constituents produced. Experiments, however, indicate that, if the ration is good,

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not enough benefit is obtained to justify the added cost. Malting of grains produces a marked increase in riboflavin.

Sprouting, or germination, of grains has been advocated as an economical procedure. The young leaves formed increase palatability. Some of the B vitamins, especially riboflavin, are increased. The salts usually added supply essential mineral elements. Studies of the process have not shown it to be practical or economical under most conditions.

Shredding and Cutting Roughages

Cutting or shredding fodder, stover, and other fibrous roughages makes them easier for the animals to handle, so that they are more completely cleaned up, although their digestibility is not increased by the process. It rarely pays to cut or grind hay. Roughage should never be finely ground.

Pelleted Feeds

Many commercial feeds are marketed in pellet form. Their chief advantages are ease of handling and reduction of wastage, especially on the range. Increased consumption, followed by greater growth and higher production rates, sometimes results.

Feeding Beef Cattle

Pasturage and roughage, preferably pasturage, should be the foundation of the ration for beef cattle. Corn is the most widely used concentrate for fattening cattle, but it contains too little protein to be used economically without legume hay or a protein-rich concentrate. Silage is an excellent feed for most classes of beef cattle. Very little roughage is wasted when it is fed as silage.

Water and Salt Needs

An adequate supply of clean, pure water for all beef animals is necessary. If possible, water should be available at all times; if not, the animals should be watered two or three times daily. Depending on its size, the feed it receives, and the climate, an animal will drink 5 to 10 gallons daily. In very cold weather, cattle may not drink enough unless the water is warmed for them.

Beef cattle require from ⅓ to 1 ounce of salt a head daily, depending on their feed. It is usually best to keep salt before them at all times.

Other Mineral Needs

Throughout most of the United States, cattle on good pasture or fed liberally on good legume hay require no minerals other than common salt. Where the soil is deficient in phosphorus or when the cattle are pastured on mature, dry grass or fed non-leguminous forage most of the year, from 35 to 50 pounds of phosphate a head a year is needed (fig. 3).

Cereal grains are deficient chiefly in calcium and that deficiency may be corrected by feeding green leafy legume hay. When it is not possible to feed such hay, cattle should have access to a mineral mixture of equal parts of salt and finely ground limestone or other cheap source of calcium (p. 6).

Feeding Beef Breeding Animals

Keep the breeding herd on pasture as long as the pasture will maintain the cattle without becoming grazed too closely. Supplement with soiling crops, silage, hay, or concentrates a pasture that is not sufficient. Breeding cows may be allowed to lose some weight during winter if they are in good condition at the end of

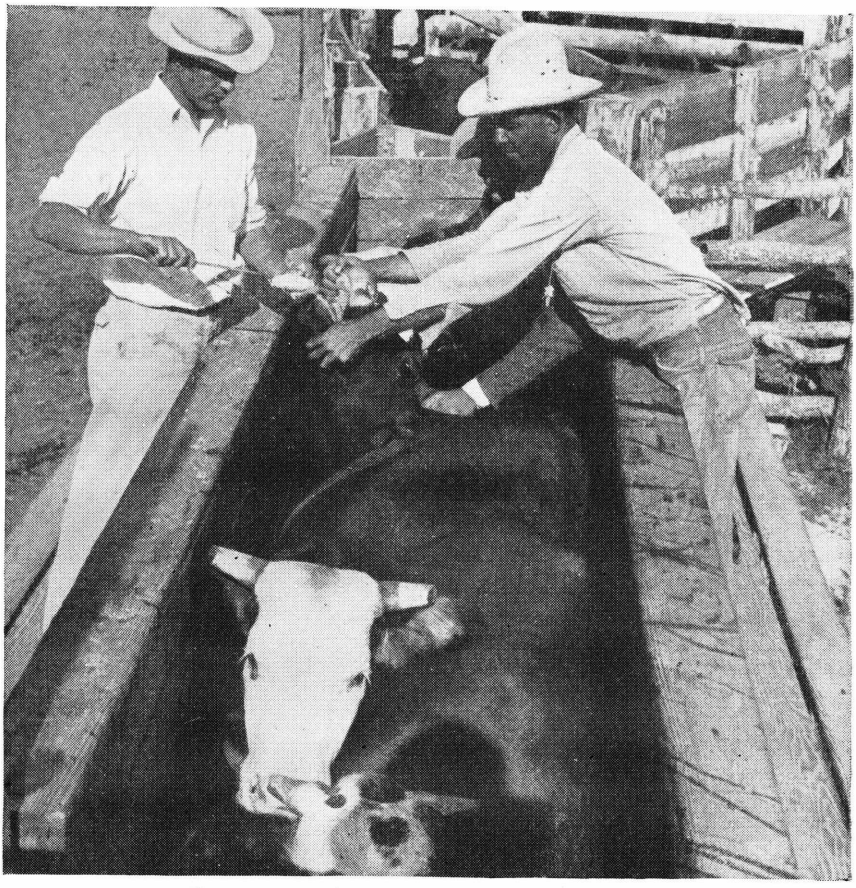

Figure 3.—Feeding cattle a mineral supplement

the grazing season. Silage and legume hay make a good combination for winter feeding. It is more economical to feed hay from a rack than from an open stack. If legume hay is not available, feed some protein-rich concentrate, such as cottonseed, soybean, or linseed meal.

Feeding Beef Bulls

Herd bulls should enter the breeding season in a healthy, vigorous condition. A ratio of 1 to 1½ pounds of a grain mixture of equal parts by measure, or 3, 1, and 1.5 parts by weight, of corn, bran, and oats to 1 to 1¼ pounds of legume hay to 100 pounds live weight a day is satisfactory. Feed this ration before and during the breeding season.

Feeding Beef Calves

Young calves on good pasture, with plenty of milk from their dams, do not usually require additional feed. However, if they are to be sold when weaned or soon afterwards, they should be fed grain. A good grain mixture for creep-fed calves consists of 3 parts by weight each of cracked corn, crushed oats, and wheat bran, and 1 part of linseed meal.

Be sure that the calves are on feeds which keep them growing before they are weaned. If possible, when calves are to be weaned, take them away from their dams abruptly. Keep them where they can neither see nor hear the cow. Keep the troughs clean and feed no spoiled or moldy feed.

The orphan calf may be fed according to the directions for hand-feeding dairy calves (p. 24), or it may be nursed by a cow with good milk production which is nursing a calf about the same age.

Feeding Beef Breeding Stock

Heifers and young bulls intended for breeding should be kept growing well throughout the entire year, so as to attain full size. If they are stunted while young, the expense of bringing them to maturity may be increased. However, it is not necessary to maintain beef breeding herds on heavy feeds of grain. If they are provided with an ample quantity of good pasturage or an adequate supply of good-quality roughage, young beef stock will generally keep in good condition.

Feeding Cattle for Market

Calves that are marketed as fat yearlings should be from well-bred stock of excellent beef type. The calves must be kept growing rapidly. If their dams are not supplying enough milk, give the calves grain, even though they are on good pasture. They should be eating grain readily before being weaned, so they will keep on growing and fattening without interruption. Young cattle require a higher percentage of protein and of concentrates in the ration than do older cattle in order to fatten properly (fig. 4).

Spring calves, weaned in the fall, and carried in the feed lot through winter, should be ready to sell the following spring without being turned out to pasture. Fall calves may be weaned the next spring as soon as good pasture is available. They should be taught to eat grain during the winter and should be continued on a full feed of grain after being put on pasture. Although they may be finished on pasture and sold early in the fall, it sometimes pays to feed them in a feed lot for 60 to 100 days before marketing. If properly fed, young beef animals should be ready for market at 12 to 18 months of age.

Cheap pasturage or other roughage is essential for feeding stockers or other cattle to be held at a maintenance level. Stockers should be kept growing at a rate of 250 to 300 pounds increase a year. As gains are generally more economical on good pasture than on harvested feeds, it often pays to feed stockers, except calves, so that they lose a little weight during winter, unless the feed available is unusually cheap. Calves should at least maintain their weight during winter, so that they will continue to grow in size, even though they lose a little in condition.

Wintering Beef Calves and Yearlings

Weaned calves may be wintered satisfactorily on 10 pounds of bright legume hay a head daily and yearlings on twice this quantity, but other rations are frequently more economical. However, if yearlings are to be turned out on grass the following summer and a maximum yearly gain is desired, they should be fed so as to gain from 50 to 75 pounds during winter.

The following rations are suggested for wintering 350-pound calves and 600-pound yearlings:

WINTERING RATIONS

RATION 1 FOR CALVES	*Pounds*
Silage	12
Legume hay	5
RATION 2 FOR CALVES	
Silage	12
Nonlegume hay	4
Protein meal	¾

RATION 1 FOR YEARLINGS	*Pounds*
Silage	20
Clover and timothy hay	5
Straw	3
RATION 2 FOR YEARLINGS	
Legume hay	14
Straw or stover	14

Feeding Steers in Dry Lot

Mature steers usually fatten in 3 to 4 months of feeding; 2-year-olds in 5 to 6 months; yearlings in 7 to 8 months; and calves in 8 to 10 months. Start steers on feed gradually, giving nearly all roughage at first and increasing the concentrates slowly until the steers are on full feed after 30 to 45 days. Keep them always ready for more feed. Do not overfeed. The efficiency of utilization of feeds for gains in weight decreases as the steer becomes fatter. Increase the proportion of concentrates in the diet throughout the

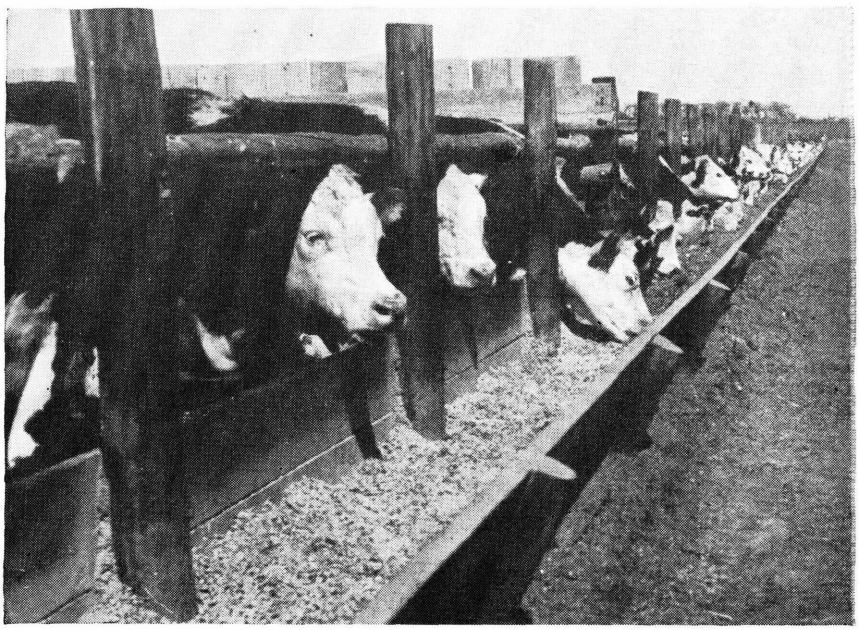

Figure 4.—Cattle-feeding equipment in a large feed lot.

feeding period. In most sections, the use of a considerable portion of silage increases the economy of the gains during fattening (fig. 5). All laxative feeds should be reduced the last 2 to 3 days before shipping cattle and some dry roughage, such as timothy or other grass hay, should be fed.

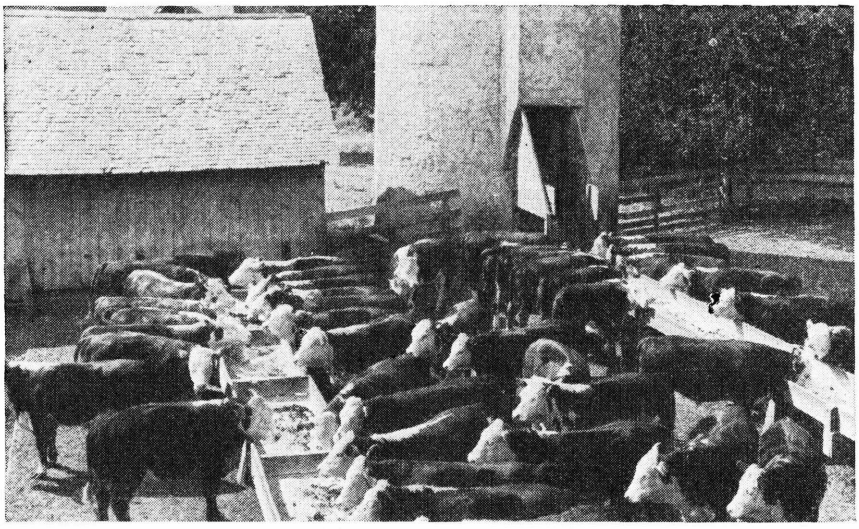

Figure 5.—Hereford steers feed at bunks conveniently near silo and barn.

The best ration is usually the one which permits the largest gains in weight at the lowest cost. In general, crops grown locally or on the home farm are the most economical to use in the ration. The proportion of concentrate to roughage, the kind of protein supplement to balance the corn or other fattening feed, and other problems depend for their solution on the availability and the relative price of the different feeds.

The following rations are suggested for fattening 2-year-old steers of approximately 1,000 pounds live weight:

FATTENING RATIONS FOR STEERS

RATION 1	*Pounds*
Corn	20
Legume hay	8

RATION 2	
Corn	20
Cottonseed meal	2
Mixed hay	5

RATION 3	*Pounds*
Sorghum grain	15
Cottonseed meal	2
Sorghum Silage	25
Legume hay	2

RATION 4	
Corn	14
Linseed meal	2
Mixed hay	5
Corn silage	25

In general, cottonseed meal, soybean meal, and linseed meal may be substituted for one another, pound for pound, depending on which is the cheapest.

When fattening cattle are being fed corn, corn silage, and other feeds with whole grains, hogs should follow them to consume the undigested grain. At least one 100-pound hog should be provided for each 1,000-pound steer.

Feeding Steers on Pasture

Whenever possible, pasture should be the foundation for feeding steers; gains made on pasture are usually the cheapest. It often pays to supplement pasture with grain in order to produce the desired grade of slaughter cattle in a reasonable time. The problem that often faces the feeder when finishing cattle on grass is whether to feed a supplement for part of the grazing period or for the entire pasture season. The answer will depend somewhat on how the cattle were fed during the previous winter and the quantity and quality of pasture available. If the cattle were well wintered and fed considerable grain, it may be desirable to feed a supplement throughout the grazing period. If they were carried through the winter on silage and dry roughage with a little meal or cake and there is abundant good-quality grass, it may be just as satisfactory to feed a heavier grain supplement only for the last half of the pasture period.

Corn alone is the supplement most extensively used for fattening steers on grass. It may be replaced by corn-and-cob meal, ground barley, or, in part, any cereal grain. Bluegrass is the principal pasture grass for fattening steers in the Middle West and Appalachian region; bluestem, buffalo, wheat, and grama grasses are highly satisfactory in the Great Plains. Steers should either be marketed off pasture before they begin to lose weight in late summer or finished in the dry lot if pastures fail.

Feeding Dairy Cattle

In general, dairy cattle, except cows producing milk, are fed the same way as beef cattle. Their feeds should be of good quality, abundant, and low in price. The foundation of the dairy ration should be a plentiful supply of roughage that is palatable and of good quality, either pasturage or hay and silage. The roughages should be supplemented, when necessary, by concentrates containing enough protein.

All grains should be ground or crushed before being fed to dairy cattle. Grinding hay for them does not pay, but chopping coarse, fibrous hays, fodder, or stover will result in an increased consumption of the coarse parts.

Dairy cattle should have ready access to salt at all times, especially cows producing milk. Salt may be mixed in the concentrate ration at the rate of 1 part for each 100 pounds of grain, but high-producing cows should be allowed more.

Cattle on good pasture or fed plenty of good-quality hay or silage usually will receive an adequate supply of mineral elements. It may be desirable to feed additional calcium or phosphorus, in such a form as bone meal, to high-producing cows. Where iodine is deficient it may be desirable to provide that element as directed on page 8.

The water supply for cows in production is especially important. Large quantities of water are required for the secretion of milk. Although the amount varies through a wide range, a consumption of 15 to 25 gallons is considered average. Cows should have water available at all times or be allowed to drink at least twice a day, more frequently in warm weather. If the water is too cold, dairy cows may not drink enough, so the water should be warmed or the

cows allowed to drink more often. Individual watering cups used in the stable should be easy to clean.

Feeding Dairy Cows

During the period of milk production and while dry the dairy cow should have enough food to keep her in good flesh and in a healthy, thrifty condition, but not enough to fatten her (fig. 6). The optimum calving interval is about 12 months, with a 10-month milking and a 2-month dry period.

The most favorable conditions for the production of milk are provided by pasturing the herd on abundant young succulent grasses and legumes. During spring or early summer, for a period of a month or so, a permanent pasture may supply all the feed a cow will need, even for rather heavy milk production. In most localities, however, climatic conditions and growth habits of the pasture plants usually result in a pronounced decrease later in the pasture season in the quantity and value of the feed available to the animals. It is usually necessary, therefore, in late summer and early fall to provide some other roughage, to feed more of a concentrate mixture, or to do both. A supplementary pasture of such crops as lespedeza, Sudan grass, millet, sweetclover, or alfalfa will often solve this problem.

Turning the cattle on the aftermath which grows up after hay has been harvested is one of the most economical means of furnishing additional feed late in the pasture season. Another means of maintaining milk production at this time of the year is feeding corn or other soiling crops. As there is no practical way of determining how much pasturage a cow eats, the supplementary feed she requires must be estimated. Observe the condition of the cows and note whether the milk flow is being maintained satisfactorily. If a cow loses much flesh or her milk flow falls off, she needs more feed.

Figure 6.—Grass silage, made by wilting the cut crop slightly and then ensiling it in a tight silo without preservatives, is fed to cattle, which find it most palatable.

Winter Feeding

The most economical basis of the diet for winter feeding of the dairy cow is a liberal quantity of a good, palatable legume hay, preferably alfalfa or grass silage, or both, together with corn

silage. The more the cows eat of such roughage, the less they need of the expensive concentrates. Producing cows should eat 2 to 3 pounds of hay, or its equivalent in hay and silage, to 100 pounds of body weight a day. Legume hays especially are valuable because of their high content of proteins and mineral elements. Silage is of value because of its carbohydrate and carotene content and because cows will consume more nutrients in the form of silage and hay than in the form of hay alone unless the hay is of high quality. Sometimes it is desirable or necessary for a farmer to make all his hay crop into silage in order to save it in a form suited for yielding the greatest value to dairy cows. The silage can replace a large part of the hay allowance in the ration. Cows will eat from 2½ to 3 pounds of hay silage for every pound of hay ordinarily fed.

Dry cows and low producers may be carried through winter on good hay or hay and silage alone, but high-producing cows will not maintain their production unless they are given enough concentrated feed in addition. For best results the weight of the milk produced should be determined and all feeds should be weighed (cover).

Concentrate Allowance

Every cow should be fed concentrates according to her needs. It is wasteful to give each cow the same quantity, regardless of her production. Low producers will be fed more concentrates than they will pay for. Cows that are inherently high producers will fail to give as much milk as they are capable of giving; they will become thin and slump in milk production. All cows fed home-grown forages should have at all times all the pasture grass, hay, or silage, or all of them that they can eat. Certain cows at certain times may need no other feed, but most cows usually require some concentrates to maintain their production of milk.

The concentrate allowance depends on the quantity of forage eaten, the amount and richness of milk produced, and the relative prices of concentrates and milk. The heavier the feeding of concentrates the greater will be the production of milk, but as the feeding of concentrates is pushed to higher levels the return for each increase in concentrates becomes less and less, so that it usually does not pay to feed cows to the limit on concentrates. However, it usually pays to feed the moderate amounts of concentrates specified in table 3 (p. 61). Some increase in these amounts should be made if concentrates are low in price as compared with milk (if the value of concentrates is less than 75 percent of the value of an equal weight of milk). If hay is expensive or if the cows tend to become thin or decline unduly fast in milk production, it will pay to feed more concentrates.

Make any increases in concentrates gradually, usually not faster than 1 pound every other day. After a cow freshens, take 2 to 4 weeks to get her on full feed. If a cow fails to eat within 30 minutes all of the concentrates given her, remove the refused concentrates from the manger at once and give her less at the next feeding.

Protein Content of Concentrates

The more protein the dairy cow receives in her forage allowance the less protein is needed in the concentrates. For example, if a

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cow is on good pasture, or if she eats 1⅓ pounds or more a day of good legume hay for each 100 pounds live weight (a 900-pound cow, 12 pounds; a 1,200-pound cow, 16 pounds), the concentrates need not contain more than 12 percent total protein. Cows producing very heavily, or more than about 1½ pounds of butterfat a day, require either more legume hay or more protein in the concentrates. If a dairy farmer has good pasture in summer and if he feeds plenty of good legume hay in winter, his cows will need no more protein than will be supplied in his farm grains.

Mixed hay has less protein than legume hay alone. More protein is needed in the concentrates that are fed with this kind of hay—16 percent instead of 12 percent.

With straight grass hay, silage, or fodder the protein content of concentrates should be 18 percent.

The following grain and concentrate mixtures will provide 12, 16, or 18 percent protein, for use in supplementing the various kinds of roughage:

12 percent protein:
- Oats.
- Barley.
- Oats and barley, equal parts.
- Corn, oats, barley, and wheat bran, equal parts.
- Corn 70 parts, oats 20, oilseed meal (soybean, linseed, etc.) 10.

16 percent protein:
- Wheat bran.
- Wheat bran and middlings (mill run).
- 50 parts corn, 30 oats, 20 soybean meal or cottonseed meal.
- 40 parts corn, 25 oats, 20 bran, 15 soybean meal or cottonseed meal.
- 50 parts corn, 35 bran, 15 soybean meal or cottonseed meal.
- 50 parts barley, 30 oats, 20 linseed meal.

18 percent protein:
- 50 parts oats, 30 bran, 20 linseed meal.
- 40 parts corn, 40 bran, 20 soybean meal or cottonseed meal.
- 40 parts corn, 35 oats, 25 soybean meal or cottonseed meal.
- 30 parts corn, 25 barley, 25 bran, 20 soybean meal or cottonseed meal.

Feeding Calves and Young Stock

Give the new-born calf its dam's first milk, or colostrum, until the milk is fit for human use. This milk is somewhat laxative, helps to clear out the calf's digestive tract, and helps to protect the calf against infection.

Separate a calf that is to be raised by hand from the cow and keep it in clean, dry quarters, which are well ventilated, but free from drafts and not too cold. Wash all utensils used in feeding the calf thoroughly after each feeding.

It is better to feed too little than too much milk, for the young calf's digestive system is easily upset. For the first few days feed warm, fresh milk 2 or 3 times a day, allowing 5 to 8 pounds daily, depending on the size of the calf. Give a 50-pound calf 5 pounds, an 80-pound calf 8 pounds, and larger calves slightly more. If the calf is digesting the milk properly, the daily allowance may be increased 1 to 2 pounds during the second week. Feed the calf at regular hours. The proper temperature of the milk is between 90° and 100° F.; the quantity should be weighed.

If the calf is growing well, skim milk may be gradually substituted for whole milk after the second or third week. At least 10 days should be taken to make the change. If the manure becomes

liquid or pasty—a condition known as diarrhea or scours—the milk is not being digested properly. If this occurs, stop any further substitution of skim milk until the condition disappears. Feed the skim milk warm. Increase the daily supply of skim milk by 2 pounds every week until the calf is getting 12 to 16 pounds. Continue the skim milk to 6 months if a cheap supply is available.

If skim milk is not available, the calf may be raised on other feeds, such as fresh buttermilk, fresh whey, dried skim milk, dried buttermilk, semisolid buttermilk, and special calf meals. (Suitable feeding methods with such substitutes are given in Farmers' Bulletin 1723.)

When the calf is 2 or 3 weeks old provide drinking water for it and start it on hay and grain (fig. 7). Begin with a small quantity of good green hay and a handful of whole or coarsely ground corn or oats. Add a little wheat bran or linseed meal to the grain unless a legume hay is fed. The quantity of grain fed should be about ½ pound daily at 4 weeks of age, 1 pound at 6 weeks, 1½ pounds at 8 weeks, and 2 pounds at 10 weeks. From the age at which the calf will eat 3 pounds of grain a day to the end of the first year, this allowance of grain will be enough to bring about good growth, provided it is fed along with plenty of good hay or hay and silage.

From 1 to 2 years of age the heifers may be fed exclusively on pasturage in summer and good hay and silage in winter, or they may be fed grain in addition. If they are to be large enough to freshen at 2 years of age they will ordinarily need 3 or 4 pounds of grain a day during the second year. However, there is no objection to lighter feeding if they are bred to freshen at an older age.

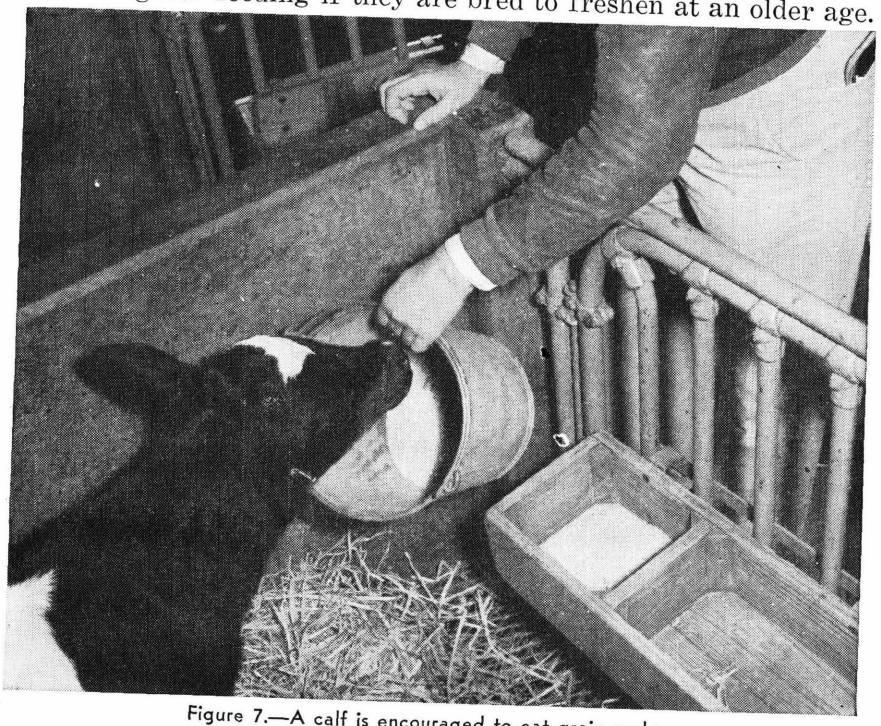

Figure 7.—A calf is encouraged to eat grain early.

In any event, the heifers at calving time should not only be of good size but should also be in a good state of flesh.

Feeding Dairy Bulls

Bulls should be fed enough to keep them in a medium state of flesh, but not fat. They should be fed a good-quality roughage. A light feeding of corn or hay silage is recommended as a source of carotene. In addition, they should receive from 5 to 10 pounds of concentrates daily, depending on their condition and the service required of them.

The best place to keep a bull in summer is a small pasture. The feed from that source is good for him and the exercise obtained tends to keep him in good condition. On pasture the bull should receive enough concentrates to maintain him in medium flesh.

Feeding Hogs

Corn is probably the feed most commonly used in feeding hogs, but corn alone will not furnish enough protein, vitamins, or minerals. It should be supplemented by such other feeds as tankage, fish meal, wheat middlings or shorts, linseed meal, soybeans, skim milk, buttermilk, good pasturage, or leafy green legume hay. If feeds like barley, wheat, rye, sorghum, peanuts, and sweet potatoes are fed, the proper supplementary feeds should be provided. To avoid production of "soft pork," the feeding of peanuts and soybeans must be restricted.

Good pasture for growing pigs, brood sows, and other hogs is good insurance against mineral and vitamin deficiency. It often means the difference between profit and loss in hog raising.

Feeding Garbage to Hogs

When properly managed, feeding garbage to hogs is a practical method of pork production. The garbage should be collected frequently and be free from injurious articles. Frozen garbage should be thawed before being fed. Raw garbage is readily eaten by hogs, but there is danger of infestation with trichinae, unless garbage containing bones and meat scraps is kept separate and thoroughly cooked before being fed.

Hogs should be immunized against cholera before being fed garbage, for there is a possibility of acquiring that disease from raw pork which may be present.

Self-Feeders

Self-feeders (fig. 8) are valuable in feeding hogs. Their use tends to save feed and labor and to produce more rapid gains. The grain and protein supplement may be mixed together, or they may be fed in separate compartments of the feeder, allowing the pig to choose for itself. Experiments show that the pig usually balances its diet properly, eating relatively less of the high-protein feeds as it gains in weight. Self-feeders are sometimes used for sows suckling pigs, but not ordinarily for breeding stock.

Hogging-off Crops

Harvesting some feed crops by hogs saves labor, helps to maintain soil fertility, and is in accord with sanitary management. However, some feed is wasted, especially during bad weather.

Figure 8.—A self-feeder set on concrete provides feed for young pigs with a minimum of waste.

Such crops as corn, peanuts, sweetpotatoes, and small grains, in pure stands or interplanted with rape or legumes, are often hogged-off. Pigs weighing at least 100 pounds are best for this type of feeding. Best results are obtained when an adequate mineral mixture and protein supplement are available in a self-feeder. Abundant green grazing in the form of palatable weeds or interplanted rape or legumes, however, will reduce the amount needed.

Remove the fattening hogs before the crop is completely harvested and let breeding stock clean up the remaining feed. Use of temporary fencing to allow successive areas to be harvested reduces feed wastage. If hogs are used to harvest sweetpotatoes, it is best to ring part of the animals; those without nose rings dig more potatoes than they eat and the ringed animals clean up the excess.

Hogs Following Cattle

Hogs are frequently used to salvage wastes in cattle feeding. They can utilize waste feed around the troughs, as well as undigested grain in cattle droppings. Older cattle, which masticate their feed less thoroughly, furnish more recoverable feed than young cattle. Cattle receiving ground grain furnish less recoverable feed than those fed whole grain. Thrifty, growthy pigs 100 pounds or more in weight are preferred for this purpose and one pig is allowed to one, two, or three steers, depending on the type of diet and the age of the steers. Supplemental feeding of the pigs with protein concentrate and minerals or even additional grain usually pays and may be necessary to insure satisfactory gains.

On the average, hogs recover from 4 to 5 percent of the feed given to steers.

Antibiotics for Swine

In swine feeding, antibiotics are recommended primarily as supplements to growing and fattening rations (fig. 9). The responses of unthrifty, runty pigs to antibiotic supplementation have been especially noteworthy. Under average conditions, however, growing pigs generally show some acceleration of growth due to antibiotic supplementation. This increase is comparable to that produced in poultry. Despite reports of benefits from feeding certain antibiotics to breeding swine, the evidence is not conclusive. Their use in the creep feed of suckling pigs is recommended, however. Because of the different responses to various antibiotics, it is advisable to follow the feeding directions of the manufacturer and also to seek advice from county agents and extension specialists.

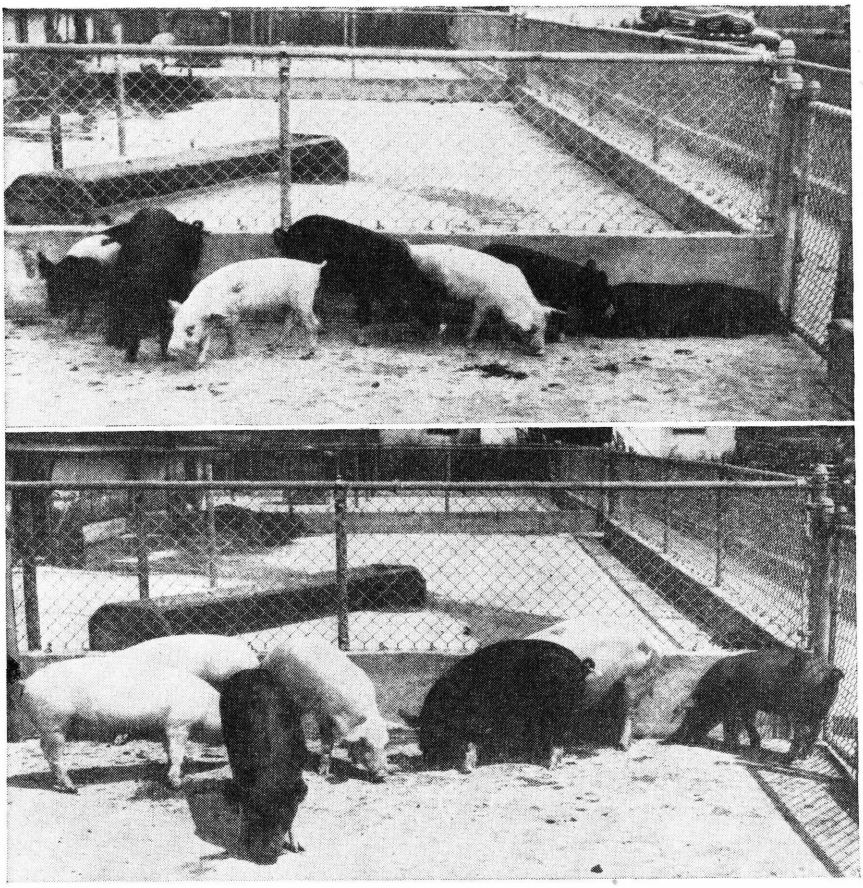

Figure 9.—Two groups of unthrifty pigs were placed on experiment at 12 weeks of age. The control group (top) received a good basal diet consisting of corn, soybean meal, linseed meal, alfalfa meal, tankage, fish meal, and mineral mixture. The other group received the same basal diet plus a concentrate containing vitamin B_{12} and aureomycin. Pictures were taken during tenth week of experiment.

Because of their effects on bacteria, antibiotics are not generally suited to the feeding of ruminants. Experiments indicate possibilities of use in young calves and perhaps in lambs before the rumen has developed its normal functions.

Although the results of antibiotic supplementation are sometimes rather spectacular, such supplementation does not replace good management and nutrition. Antibiotics can not take the place of required nutrients or approved livestock sanitation.

Minerals for Hogs

A diet containing corn or other cereal grains, supplemented with such feeds as skim milk, tankage, or fish meal, usually furnishes enough calcium and phosphorus to meet the pig's mineral requirements. However, it is common practice to supply a mineral mixture in a box or self-feeder, so that the pig may have access to the mineral elements which may be lacking in its diet. Many combinations have been suggested for supplying the salt, calcium, and phosphorus deficiencies in the feed of hogs. A mixture of equal parts by weight of common salt, steamed bone meal and ground limestone or air-slaked lime plus 2 percent of copperas (ferrous sulfate) is palatable and contains the minerals commonly needed for supplementing grains. This mixture may be fed to pigs on pasture or in the dry lot. Where there is danger of goiter, it is advisable to substitute commercial iodized salt for regular salt or to add potassium iodide at the rate of an ounce to each 300 pounds of salt.

Water for Hogs

Failure to provide enough water for hogs is a common mistake. They need from 2 to 6 quarts of water daily for each 100 pounds of live weight. In cold weather it may be necessary to warm the water. If the ration contains milk, or is fed as a slop, less water is required, but a supply should be available at all times.

Feeding Brood Sows

During pregnancy sows should be fed liberally but not so liberally as when pigs are being nursed. An overfat sow may produce pigs which are low in vitality, and she may be more clumsy with them. On the other hand, a sow that is too thin cannot nurse a litter properly.

Pregnant sows should receive feeds which contain plenty of protein, minerals, and vitamins. Alfalfa hay fed in a rack (fig. 10) is an excellent means of providing a legume supplement for sows not on good pasture. Give sows comfortable quarters with room for exercise, and keep them free of lice. Plenty of water should be available.

The sow's ration should be fed dry. Toward the end of gestation, if she shows signs of constipation, give her a little linseed meal. Root crops may supplement her diet during winter. They are succulent and laxative, but, because of their high water content, their relative feeding value is low. Feeding coarse, bulky, laxative feeds, such as bran and linseed meal, just before farrowing together with plenty of exercise, will prevent any tendency for the sow to eat her young.

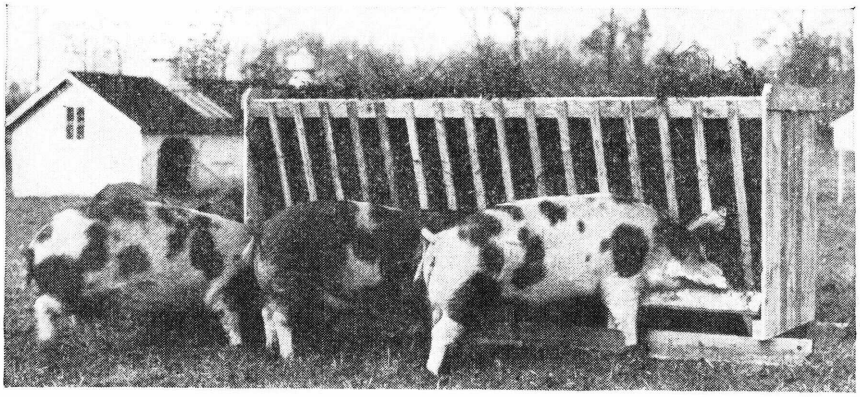

Figure 10.—Hogs at rack of legume hay.

For 3 or 4 days preceding farrowing, slightly reduce the sow's feed. After farrowing, she should have no feed for the first 24 hours, but should be liberally supplied with warm water. The first feed should be a thin slop, preferably of bran and middlings. The feed should be light for the next 3 or 4 days and then gradually increased until by the seventh to tenth day the sow can be returned to full feed.

If the pigs begin to scour, reduce the sow's feed and give her a small quantity of oats. Place a piece of rock lime slightly smaller than a baseball in a gallon of water; drain the water off the slaked lime and give it to the sow to drink. Bathe the sow's udder and teats with the limewater. In addition, give the pigs (on the tongue) 5 drops of formalin solution, prepared by mixing 1 ounce of standard-strength formalin and 1 pint of water. Wash the sow's teats once or twice daily with a solution prepared by adding 1 ounce of the prepared formalin solution to a pint of water.

After 2 or 3 weeks pigs will generally adjust their own diets satisfactorily if they are given the proper assortment of feeds in a self-feeder as a supplement to the sow's milk.

Feeding Young Pigs

Pigs confined indoors or in pens with paved floors, without access to the soil, may suffer with anemia. To prevent this, provide about 50 pounds of clean sod or soil containing 10 grams of ferrous sulfate and 1.5 grams of copper sulfate. The copper and iron compounds are dissolved in a pint of hot water and the solution sprinkled over the soil. Anemia may be prevented also by giving each pig ⅓ teaspoonful of saturated ferrous sulfate solution once or twice the first week and increasing the dose to 1 spoonful in the third or fourth week. Continue this treatment till the pigs are 6 weeks old.

A self-feeder containing a good mixed diet that has 20 to 22 percent of protein should be available to the pigs when they are about 3 weeks old. As an alternative, wheat middlings, tankage, fish meal, soybean meal, or peanut meal may be supplied in one compartment of the feeder and shelled corn in the other. The pigs will grow faster and be more thrifty if they have access to a good pasture.

Hand-feeding Newborn Pigs

If at all possible, pigs should obtain the colostrum, or first milk, of the sow. If a sow fails to produce enough milk for her pigs, some or all of them may be fed by hand. Satisfactory results have been obtained with fresh cow's milk, reconstituted dried whole milk, diluted canned evaporated milk, and reconstituted dried skim milk with fat added. The addition of 4 grams (1 teaspoonful) of antibiotic feed supplement, 4 grams (1 teaspoonful) of dried brewers' yeast, and 5 milliliters (1 teaspoonful) of cod-liver oil to a gallon of milk increases the life expectancy of orphan pigs and also their daily gains. A saturated solution of iron sulfate may be added to the milk (after it is warmed for feeding) at the rate of 1 or 2 milliliters (¼ teaspoonful) to each pig daily to prevent anemia. Cleanliness should be maintained in caring for feeding utensils and in feeding and handling milk. Frequent feeding of small quantities is important with very young pigs. For the first week of life they should be fed every 4 to 6 hours, after which they may be fed every 8 hours. Warming the milk is advisable for very young pigs, but can be discontinued after the first week without ill effects. The pigs may be bottle fed, but teaching them to drink from shallow troughs or pans takes less labor. Commercial preparations are available for rearing orphan pigs or for supplementing the supply of a sow's milk. Compare the cost and convenience of these preparations with those of home-mixed formulas to determine which to use. At 5 to 6 weeks of age, the amount of milk may be gradually reduced until the orphan pigs are shifted entirely to dry feed at the usual weaning age, or earlier. In any case, they should have access to grain or mixed feed at 2 or 3 weeks of age.

The following diets for hand-feeding baby pigs are suggested:

	Diet—			
	1	*2*	*3*	*4*
	Parts	*Parts*	*Parts*	*Parts*
Evaporated milk (canned)	75	.....	.....	.....
Dried skim milk (powder)	.....	.....	.....	15
Dried whole milk (powder)	.....	20	.....	.....
Cow's milk, fresh	.....	.....	100	.....
Lard (or other fat)	.....	.....	.....	6.5
Water	25	80	.....	78.5

Supplements to each formula: Cod-liver oil, 5 milliliters (1 teaspoonful) per gallon of liquid.

Antibiotic feed supplement: If antibiotic content is guaranteed from 1.5 to 3 grams per pound of supplement, add 4 grams per gallon of liquid; if antibiotic content is guaranteed from 4 to 6 grams per pound of supplement, add 2 grams per gallon of liquid.

Mineral solution: To 1 quart of water add 50 grams of ferrous sulfate, 4 grams of copper sulfate, 4 grams of manganese chloride, and ¼ gram of potassium iodide; give 1 milliliter (¼ teaspoonful) of solution per pig daily, stirring it into the milk at any feeding.

Lard, though a cheap source of fat in the reconstituted skim-milk diet, is difficult to blend into milk without a high-speed mixer. If cost permits, butter, margarine, cooking oil, or other fat may be substituted for lard.

Weaning Young Pigs

Wean pigs at 8 to 12 weeks of age, depending on the condition of the pigs and sow and on whether the sow is to raise one or two

litters a year. It is important that pigs be eating grain before weaning. Four or five days before that time, cut the sow's feed at least one-half. Do not change the diet of the pigs at weaning time, except to add a limited quantity of skim milk if available. An abrupt change in diet should be avoided. Good pasture is the best substitute for milk at the time the pigs are weaned.

Feeding Young Pigs Kept for Breeding

Pigs to be kept for breeding should be well fed to provide for good growth and development of bone and muscle, but they should not be allowed to become fat. After young gilts are bred, they should receive enough feed to produce their litters and finish their own growth properly.

Feeding Fattening Pigs

Feeding pigs for market covers two periods: The growing period, from the time of weaning to about 8 or 10 weeks before marketing; and the fattening period.

During the growing period, feed the pigs about the same as those intended for breeding. Give them about 50 percent more grain than the breeders, as well as plenty of pasture. The daily grain allowance, with pasture, should usually be about 3 percent of the animal's body weight.

During the fattening period use more grain and less protein concentrates. A good concentrate mixture for pigs on green pasture is 20 parts by weight of corn to 1 part each of tankage and soybean meal. Changes in the diet should be slow and the feed should not be increased too rapidly, or the pigs may go off feed. Pastures of such crops as alfalfa and clover are excellent for keeping the appetite keen. Pigs may be successfully carried from weaning time to marketing by supplying corn, protein concentrates, and minerals in separate compartments of a self-feeder.

Formulas for mixed feeds for self-feeding hogs in dry lot are as follows:

WEANING TO 100 POUNDS WEIGHT

DIET 1	*Pounds*	DIET 2	*Pounds*
Ground corn	70.0	Corn	62.0
Tankage or fish meal	6.0	Oats	20.0
Linseed meal	6.0	Tankage or fish meal	6.0
Soybean meal	7.5	Alfalfa leaf meal	5.0
Middlings	3.5	Soybean meal	6.0
Alfalfa leaf meal	6.0	Mineral mixture	1.0
Mineral mixture	1.0		

100 POUNDS WEIGHT TO APPROXIMATELY 225 POUNDS WEIGHT

DIET 1	*Pounds*	DIET 2	*Pounds*
Ground corn	81.0	Corn	20.0
Tankage or fish meal	2.0	Barley	46.5
Linseed meal	4.0	Wheat	20.0
Soybean meal	7.0	Soybean meal	8.0
Alfalfa leaf meal	5.0	Alfalfa leaf meal	4.0
Mineral mixture	1.0	Mineral mixture	1.5

Separate compartments of the feeder are often used for the grains and the protein and mineral mixture, thus allowing the hogs to balance their own ration, free choice.

FORMULAS FOR PROTEIN-MINERAL MIXTURES

INGREDIENTS	FORMULA No.[1] 1	2	3	4	5
	Pound	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Tankage	20	10	10	10	.....
Fish meal	.....	10	.....	10	.....
Linseed meal	25	.....	20	.....	25
Alfalfa leaf meal	25	25	.....	25	25
Cottonseed meal	.....	25	20	.....	.....
Soybean meal	25	25	.....	50	50
Peanut meal	.....	.....	45	.....	.....
Mineral mixture[2]	5	5	5	5	5

[1] Supplements containing vitamin B_{12} and antibiotics may be added according to directions.

[2] Mineral mixture may be composed of: 33.9 parts by weight of ground limestone, 34 parts steamed bone meal, 30 parts iodized salt, 2 parts ferrous sulfate, and 0.1 part copper sulfate.

Skim milk or buttermilk may be substituted for fish meal or tankage. Approximately 11 pounds of skim milk will replace 1 pound of tankage. Fish meal and tankage have practically the same feeding value, and may be substituted, pound for pound, for each other. Linseed meal, soybean meal, peanut meal, or cottonseed meal may be used interchangeably in the protein part of the ration. Hogs that have access to good-quality legume crops or rape will require approximately half as much protein concentrate as pigs fed in dry lots.

Feeding the Boar

The boar should be given plenty of protein-rich feeds during the breeding season. He should have the run of a quarter acre or more of pasture, or have access to a rack containing leafy legume hay in his paddock.

Feeding Sheep

Gentle handling, regular feeding, and quiet are especially important in feeding and managing sheep. The flock in summer needs good pasture, shade, salt, and plenty of pure water. Salt should be kept before sheep at all times; they will take too much if given it only at intervals. Sheep frequently suffer from lack of water. They need from 1 to 6 quarts a head daily, depending on the feed received, weather conditions, and the water content of the forage.

The practice of harvesting corn with fattening lambs or sheep is good. Some crop, such as soybeans, velvetbeans, or rape, should be grown in the corn.

Preventing Stomach Worms

When sheep graze on pastures that are limited in range there is danger of serious stomach-worm infestation, especially with young lambs, which are more susceptible than older animals. If possible, divide the pastures and rotate the flock from one division to another about every 2 weeks. By continually providing the flock with new pasture, losses from stomach-worm infestation may be reduced.

Stomach worms, as well as certain other injurious parasites, may be controlled by the continuous free-choice administration of phenothiazine (1 part) in loose salt or mineral mixture (9 parts).

Until well established, this regimen should be supplemented by therapeutic doses of phenothiazine. The dosage for sheep is 25 grams, or about 1 ounce; for lambs, 15 grams. Treat breeder animals about 1 month before lambing. In northern climates, one or two winter treatments and free access to the salt and phenothiazine mixture during the grazing season are sufficient for good parasite control. (Farmers' Bulletin 1330 gives complete directions.)

Feeding Breeding Ewes

Before the breeding season in the fall discard all nonbreeding, poor-milking ewes from the flock. At the time the ewes are bred they should be gaining in weight. Placing the ewes on abundant pasture or adding a grain supplement 2 or 3 weeks before breeding—a practice called "flushing"—tends to increase the proportion of twin lambs and to have the lambs born near the same time.

Stubble and stalk fields, fence strips in plowed fields, late pastures, pasturage on green rye, and velvetbeans (in the South) will help carry the breeding flock through the fall and well into the winter. A mixture of legume hays and straw is usually desirable for economical winter feeding. Silage and root crops also are good feeds for wintering, if they are supplemented with a protein-rich concentrate, such as linseed meal, soybean meal, cottonseedmeal, or distillers' corn byproducts. Timothy hay that is cut when too ripe is not good for sheep.

Heavy grain feeding just before lambing may cause udder trouble. After lambing, ewes should be fed lightly at first, being put on full feed after the third or fourth day, depending on the quantity of milk needed for the lambs.

Each of the following rations contains approximately the quantity of the various nutrients required daily for ewes 110 to 140 pounds in weight:

RATIONS FOR BREEDING EWES

RATION 1	*Pounds*
Alfalfa or soybean hay	3
Corn silage	2
Shelled corn	½

RATION 2	
Alfalfa	3½
Silage	2

RATION 3	*Pounds*
Alfalfa	3
Corn stover	2

RATION 4	
Oat straw	2
Corn silage	2
Linseed meal	¼
Shelled corn	¾

Orphan Lambs

The lamb of a ewe that dies at lambing should be nursed, if possible, by another ewe which has recently lambed. If this cannot be done, the lamb should be given the colostrum milk from another ewe for at least 2 days. Feed 1 ounce every 2 hours, using a bottle with a nipple. On the third day milk from a cow or goat may be substituted. If cow's milk is used, it should be high in butterfat. For the rest of the first week, the intervals between feeding may be gradually increased to 4 hours and the quantity fed increased to 2 ounces a feeding. During the second and third weeks, gradually increase the quantity to 6 ounces a feeding. At this time the

lambs should be started on grain and hay. The daily feedings of milk may be reduced to three and the quantity increased to 1 pint at each feeding. All bottles used in feeding should be sterilized; the milk should be clean and fresh and fed at approximately 100° F.

Feeding Lambs

Well-nourished lambs (fig. 11) from well-fed ewes have few troubles. The following measures will help in clearing up difficulties that sometimes arise.

Give a teaspoonful of castor oil to any lamb that is constipated.

If lambs are sold at 3 to 5 months of age, let them run with their dams until that time. Wean lambs kept for breeding at from

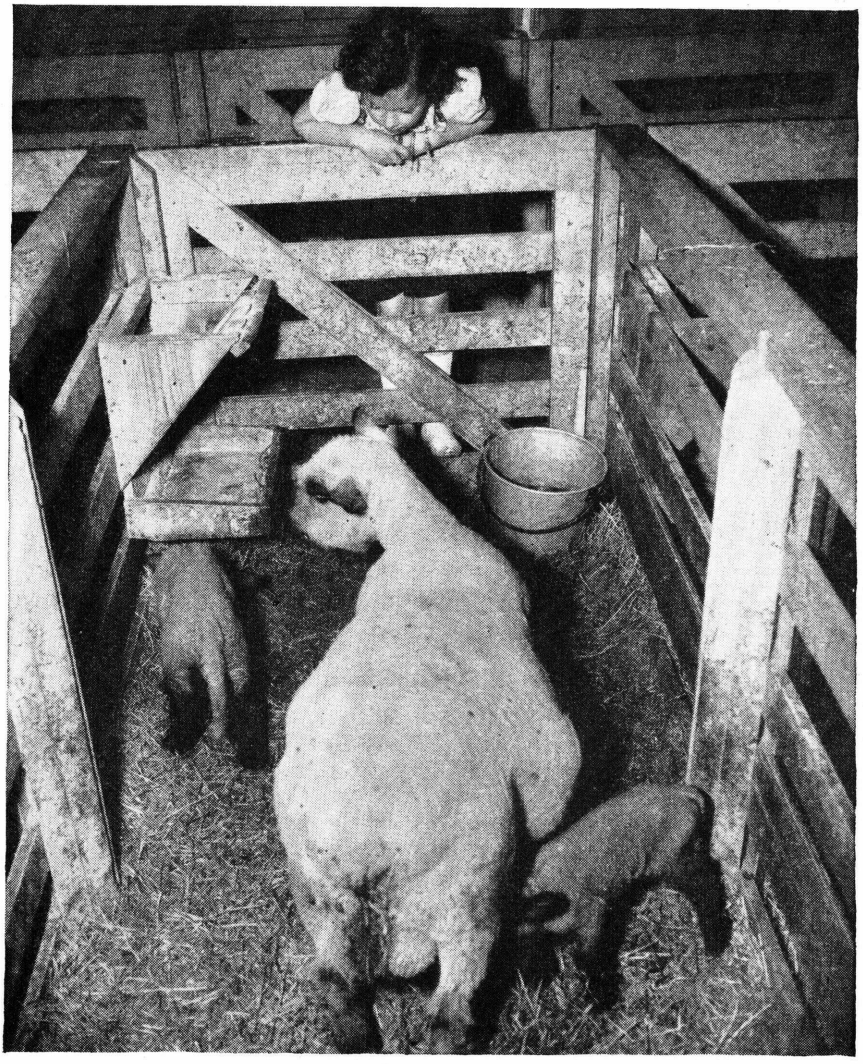

Figure 11.—Newborn twin lambs need proper feeding and care to bring out the good qualities inherited from their mother.

4 to 5 months of age and put them on fresh pasture where there is no danger of stomach worms.

When the lambs are 10 to 16 days of age give them access to a creep where they may get hay in a rack and grain in a trough arranged so they cannot get their feet in the feed. Green alfalfa hay is one of the most relished feeds. A good ration for creep-feeding lambs (fig. 12) is composed of the following parts by

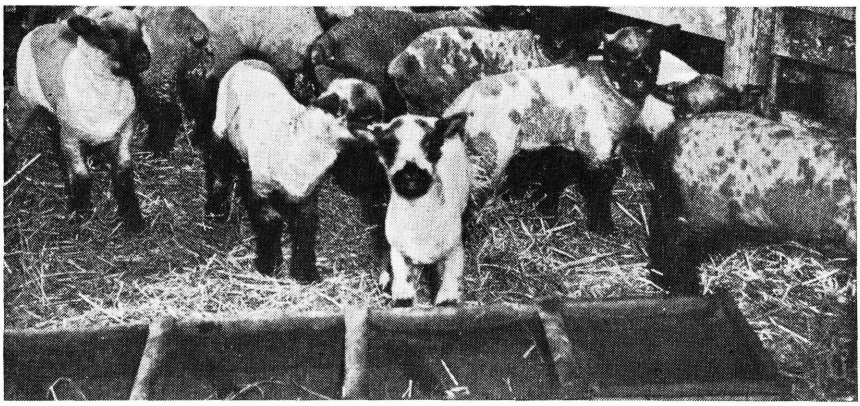

Figure 12.—Shropshire and Hampshire lambs, 1 to 4 weeks old, are fed in an enclosure from which the larger sheep are barred.

weight: Cracked corn, 2; crushed oats, 2; wheat bran, 1; and linseed meal, 1.

Until the lambs are 5 to 6 weeks old their concentrate feed should be coarsely ground or crushed. Cleanliness is important in keeping the lambs growing. Always feed them in a clean trough.

Weaning Lambs

The best method of weaning is to leave the lambs on the old pasture for 3 or 4 days, provided the pasture is luxuriant; then move them to the best available pasture and remove the ewes to a scanty pasture to check the milk flow.

Raising Lambs on Forage Crops

The practice of grazing the flock on forage crops until the lambs are sold is becoming increasingly popular where land is high in price and where stomach worms cause trouble. The lambs and ewes are allowed to graze on fall-sown wheat or rye. The land is divided so the flock is not kept on the same ground more than 10 or 14 days. By the time the second lot of this crop is grazed down, spring-grown peas and oats can be ready and the fall-wheat land plowed and sowed to another cereal or to rape or soybeans, for later use. This plan produces more feed to the acre, but requires more labor and fencing.

Fattening Lambs

In fattening home-grown or purchased feeder lambs, start them on pasture, such as stubble fields, the after-growth of hay fields, or any other forage available. The lambs may be carried on such

feed for a month or two, meanwhile gradually becoming accustomed to grain. The usual fattening period is 90 to 100 days; the lambs should gain 30 or 40 pounds a head during that time.

In starting the lambs on grain take precautions to avoid digestive disturbances. They should have a fill of good roughage and then be allowed about one-tenth pound of grain a head. After 4 to 6 weeks the lambs should be eating 1 pound of grain a head daily, together with about 2 pounds of hay or roughage. Toward the end of the fattening period, the diet should contain approximately equal portions of grain and roughage. *Clostridium perfringens* type-D antitoxin, available from certain biological manufacturers, has recently shown promise in reducing death losses from overeating. Consult a veterinarian for further information on the prevention of death by the use of vaccines.

Corn with alfalfa or clover hay is an excellent combination for fattening. Coarser hays, such as soybean hay, may be used. If good legume hay is not available, other hays may be used. but the diet must be supplemented with a protein concentrate, such as cottonseed, linseed, or soybean meal or distillers' byproducts. A mixture of 1 part of the protein concentrate with 7 parts of corn or similar feed is satisfactory. Other feeds, such as corn silage, roots, tubers, screenings, and molasses, may be used in fattening lambs. Silage must not be frozen, moldy, or excessively acid. A dry roughage, preferably legume hay, should be fed with corn silage. The grain need not be ground for lambs after the first few weeks.

Consumption of grain and rate of gain are appreciably greater with self-feeding than with hand-feeding. Grain consumption to the pound of gain in weight is likely to be greater if the lambs eat from self-feeders. For this reason, it is best to mix some bulky material, such as chopped alfalfa, in the proportion of 1 part to 3 or 4 parts of concentrate mixture.

Feeding Rams

Beginning a month before the breeding season, give rams some extra grain. Two parts of oats and one of bran, by bulk, is a good mixture. Oats alone are good also. If the ram is thin, feed a mixture of 5 parts, by weight, of corn, 10 parts of oats, 3 parts of bran, and 2 parts of linseed meal. Rams should be fed about the same quantity to each 100 pounds of weight as ewes.

Feeding Milk Goats

Milk goats should have about the same kind of feeds as dairy cows. A successful winter ration for goats in milk is 2 pounds of alfalfa or clover hay, 1½ pounds of silage or turnips, and 1 to 2 pounds of grain. The grain mixture is composed of 100 pounds of corn, 100 pounds of oats, 50 pounds of wheat bran, and 10 pounds of linseed meal. On good pasture, goats may be given 1 or 1½ pounds of the foregoing grain mixture with the linseed meal omitted.

Feeding Angora Goats

Most of the feed for Angora goats on range is browse, weeds, and grass. Evergreen brush (not cedar or other coniferous vegetation) is relied on for winter feed. While sheep and goats do not

thrive on pine needles, they may eat the buds and damage young trees. When supplementary feeds are necessary, hay, kale, rape, milo, feterita, oats, and similar feeds suitable for sheep may be used for goats.

Feeding Poultry

Well-balanced, palatable diets are essential for good results in feeding chickens. With good stock, the additional cost of a good diet is repaid many times in better growth, improved health, and greater egg production. Some general points to be kept in mind in feeding chickens follow:

A diet is not well balanced unless it supplies enough of the right proteins, vitamins, and minerals for the purpose for which it is being fed.

The kind and quantity of the proteins in the diet determine, to a large extent, both the rate of growth and the rate of egg production.

Alfalfa leaf meal or alfalfa meal of good quality should be included in the diet if green feed is not fed.

A source of vitamin D, such as fish oil or irradiated animal sterol, should be mixed with the feed if the birds are confined or are not exposed to plenty of sunshine.

When well-balanced diets are used it is economical to keep feed before the chickens at all times. All the feed, both mash and grain mixture, should be fed in hoppers (fig. 13). Feeding grain in the litter is insanitary. Self-feeders save labor and may be used in feeding dry mash or grain.

Grit is of value in feeding poultry. If the birds do not have access to soil, grit should be supplied in suitable boxes or hoppers. River gravel or native pebbles are excellent for this purpose.

Limestone or oystershell is often made available in hoppers to supply calcium to chickens. However, the diets given in this bulletin contain the correct quantities of calcium—any more would throw them out of balance.

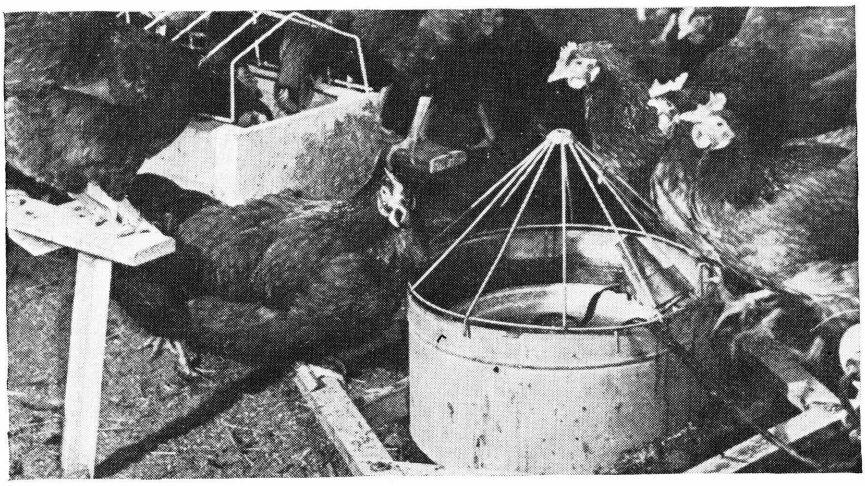

Figure 13.—Equipment suitable for feeding mash and grain. Feeding grain in the litter is insanitary.

Antibiotics for Poultry

The antibiotics aureomycin, bacitracin, penicillin, and terramycin are being widely used in starting and growing mashes and broiler mashes for chickens and turkeys. One to four milligrams of antibiotic to a pound of feed (2 to 8 grams a ton) is needed to produce the desired effect. Antibiotics are recommended for use in broiler feeds because they induce about a 10-percent increase in growth rate to 10 weeks of age and about a 10-percent increase in efficiency (fig. 14). They are recommended for turkey starting and growing diets because of their favorable effect on growth rate, which persists at least to 26 weeks of age. Their effect on efficiency of feed utilization by turkeys is much less than in the case of chickens. Whether antibiotics should be fed to flock-replacement chicks is a matter of opinion. They stimulate growth to 20 weeks of age but have little or no effect at the age of sexual maturity. They increase efficiency of feed utilization to 20 weeks of age, but the increase is so small after 10 weeks that it would hardly justify their use. Feeding antibiotics to adult birds is not recommended; they do not stimulate egg production, improve hatchability, or benefit the progeny.

Feeding Laying Hens

The following mash and grain diets are recommended for laying hens:

MASH AND GRAIN DIETS FOR LAYING HENS

Mash: DIET 1	*Parts by weight*	Mash: DIET 2	*Parts by weight*
Finely ground oats	10.0	Ground yellow corn	16.5
Wheat middling	15.0	Ground wheat	15.0
Ground yellow corn	16.0	Finely ground oats	15.0
Soybean meal	32.0	Soybean meal	25.0
Alfalfa leaf meal	8.0	Meat scrap	5.0
Riboflavin supplement[1]	5.0	Alfalfa leaf meal	8.0
Steamed bone meal	5.5	Riboflavin supplement[1]	2.5
Ground limestone[2]	6.5	Ground limestone[2]	6.0
Manganized salt[3]	1.0	Steamed bone meal	5.0
Iodized salt[4]	.4	Manganized salt[3]	1.0
Vitamin A and D feeding oil[5]	.6	Iodized salt[4]	.4
		Vitamin A and D feeding oil[5]	.6
Grain mixture:			
Whole yellow corn	50.0	Grain mixture:	
Wheat	50.0	Whole yellow corn	50.0
		Oats	25.0
		Wheat	25.0

[1] May be dried whey, dried distillers' solubles, or other byproduct containing at least 15,000 micrograms of riboflavin a pound. Supplements containing more riboflavin may be used at proportionately lower levels.

[2] Neither oyster shell nor limestone grit should be fed with either of these diets, which supply all the calcium needed.

[3] A mixture of 100 parts of common salt and 5 parts of technical anhydrous manganous sulfate.

[4] The standard commercial product is recommended. If it is not available, ordinary salt may be used.

[5] Should contain 300 International Units of vitamin D and at least 1,500 International Units of vitamin A a gram.

Feed the laying hen approximately equal quantities of the mash and grain mixtures. Either grain mixture may be used with either mash.

Plenty of clean fresh water should always be available to chickens. A flock of 50 laying hens requires about 15 quarts of water a day, preferably in a clean shallow pan.

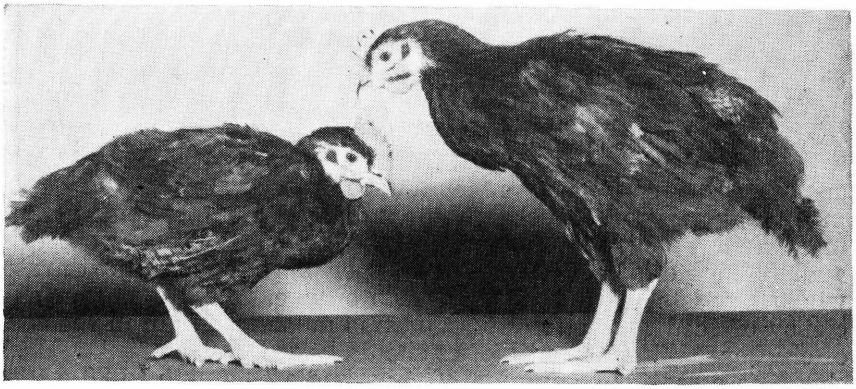

Figure 14.—Two 6-week-old Rhode Island Red chickens received the same good diet except that one (left) was given no antibiotic, while the other was given 20 grams of aureomycin per ton of feed. Each chicken represented the average of the group of males from which he was taken.

Feeding the Breeding Flock

Pay more attention to the feeding of the breeding flock than to that of hens kept for market-egg production.

All-mash diets give more uniform results when fed to the breeding flock than do the mash-grain diets. However, mash-grain diet 2 previously listed will be satisfactory for the production of hatching eggs if the meat scrap is replaced by fish meal and the level of riboflavin supplement is doubled.

See that males as well as hens get plenty of feed. The following all-mash diet is good for the breeding flock:

ALL-MASH DIET FOR BREEDING FLOCK

DIET 1	*Parts by weight*	DIET 2	*Parts by weight*
Ground yellow corn	20.0	Ground yellow corn	28.0
Finely ground oats	10.0	Ground wheat	20.0
Ground wheat	29.0	Finely ground oats	10.0
Wheat middlings	15.0	Wheat middling	----
Wheat bran	----	Wheat bran	12.0
Soybean meal	7.0	Soybean meal	12.0
Fish meal	3.0	Fish meal	3.0
Meat scrap	1.5	Meat scrap	----
Riboflavin supplement[1]	3.0	Riboflavin supplement[1]	3.0
Alfalfa leaf meal	5.0	Alfalfa leaf meal	5.0
Ground limestone[2]	3.0	Ground limestone[2]	3.5
Steamed bone meal	2.5	Steamed bone meal	2.5
Manganized salt[3]	.7	Manganized salt[3]	.7
Vitamin A and D feeding oil[4]	.3	Vitamin A and D feeding oil[4]	.3

See footnotes on p. 39.

Feeding Growing Chicks

Feed chicks as soon as possible after removal from the incubator, preferably within 48 hours. If a well-balanced diet is used, the feed may be kept before the chicks all the time. Give the chicks at one time only as much as they will consume in a single day. There should be enough feeder space so that the chicks will not be crowded when feeding.

Any grain mixture suitable for chicks may be fed with these mashes after the chicks are 6 weeks old. The quantity of grain should then be gradually increased until equal proportions of grain and mash are being fed at 15 weeks of age.

It is not necessary to supply green feed with the mashes, but if there is plenty of green feed available, corn, oats, or barley may be substituted for the alfalfa leaf meal.

STARTING AND GROWING MASHES

MASH 1	*Parts by weight*	MASH 2	*Parts by weight*
Ground yellow corn	35.0	Ground yellow corn	32.0
Ground wheat	20.0	Finely ground oats	10.0
Soybean meal	7.0	Wheat middlings	10.0
Fish meal	3.0	Wheat bran	5.0
Meat scrap	3.0	Soybean meal	28.0
Alfalfa leaf meal	5.0	Fish meal	3.0
Riboflavin supplement[1]	2.7	Alfalfa leaf meal	5.0
Steamed bone meal	2.0	Riboflavin supplement[1]	2.7
Ground limestone[2]	1.2	Steamed bone meal	2.0
Manganized salt[3]	1.0	Ground limestone[2]	1.2
Vitamin A and D feeding oil[4]	.1	Manganized salt[3]	1.0
		Vitamin A and D feeding oil[4]	.1

See footnotes on p. 39.

If the chickens get plenty of sunlight and good green feed, the vitamin A and D oil may be omitted after the third or fourth week.

Feeding Broilers

Most broilers are fed commercial broiler mashes which are complete all-mash diets. The following formulas for broiler mashes are recommended:

BROILER MASHES

DIET 1	*Parts by weight*	DIET 2	*Parts by weight*
Ground yellow corn	55.7	Ground yellow corn	59.7
Alfalfa leaf meal	5.0	Alfalfa leaf meal	5.0
Soybean meal	26.0	Soybean meal	17.0
Peanut meal, corn gluten meal, or soybean meal	5.0	Peanut meal, corn gluten meal, or soybean meal	5.0
Fish meal	4.0	Fish meal	5.0
Meat meal	----	Meat meal	6.0
Butyl fermentation solubles (250 micrograms riboflavin per grain)	.6	Butyl fermentation solubles (250 micrograms riboflavin per grain)	.6
Steamed bone meal, defluorinated superphosphates, or other low-fluorine calcium phosphate	2.0	Manganized salt[1]	.5
Ground limestone or oystershell	1.0	Vitamin A and D feeding oil[2]	.2
Manganized salt[1]	.5	Antibiotic supplement	(4)
Vitamin A and D feeding oil[2]	.2		
Vitamin B_{12} supplement	(3)		
Antibiotic supplement	(4)		

See footnotes on p. 39.

[1] A mixture of 100 parts of common salt and 5 parts of technical anhydrous manganous sulfate.

[2] Should contain 300 International Units of vitamin D and at least 1,500 International Units of vitamin A a gram.

[3] Vitamin B_{12} supplement should be used at level to supply 5 micrograms of B_{12} per pound of feed. If desired, B_{12} supplement can be omitted and level of fish meal doubled.

[4] Antibiotic supplement should be used at level to supply at least 1 milligram of procaine penicillin, or 4 milligrams of other antibiotic (p. 39), per pound of feed.

FINISHING MASHES

MASH 1

	Parts by weight
Ground corn or wheat	42.0
Finely ground barley or oats	30.0
Meat scrap	13.0
Dried buttermilk or dried skim milk	7.0
Alfalfa leaf meal	5.0
Corn oil	2.5
Salt	.5

MASH 2

	Parts by weight
Ground corn or wheat	37.5
Finely ground barley or oats	30.0
Meat scrap	5.0
Soybean meal	14.0
Dried buttermilk or dried skim milk	6.0
Alfalfa leaf meal	3.0
Ground limestone	1.5
Corn oil	2.5
Salt	.5

The corn oil, though desirable, is not essential; hence, if it is not available, it may be omitted. Mix the mashes with enough water to give the feed such a consistency that it will just pour readily. If liquid skim milk or buttermilk is available, it may be used in place of the water and the dried buttermilk or skim milk may be omitted.

Suitable mashes for fattening roasting chickens, capons, and fowls may be mixed according to the foregoing formulas, except that only about one-half the quantity of meat scrap and soybean meal should be given.

Feeding Horses and Mules

Besides the general rules for feeding horses and mules, here given, the feeder must consider the age, type, condition, and temperament of each animal and the availability of feedstuffs locally and seasonally.

Efficiency and success in feeding require that the diet be adjusted to meet individual requirements, which vary under conditions of idleness, work, reproduction, and growth. A horse doing moderate work requires approximately 50 percent more energy-producing feed than an idle horse. A pregnant mare or one nursing a foal requires more proteins and minerals than either the idle or the working gelding and than mares not with foal. The young growing horse has special requirements for body-building nutrients. Even horses of the same size and age and doing the same work often vary in their feed requirements. A nervous horse commonly needs more feed than a placid horse. Adjustments must be made to meet these differing requirements.

Take care to use only feeds that will not be injurious. The horse is the most sensitive of the farm animals to injury from spoiled, moldy, or dusty feeds. Musty or only slightly moldy hay, not ordinarily dangerous to cattle, may cause heaves in horses.

The horse relishes an occasional change in diet. Changes should be made gradually, however, particularly when the shift is from a relatively bulky feed, such as oats, to a more concentrated feed, such as corn.

Idleness or restricted exercise and overfeeding are common enemies to the horse's well-being. An underfed horse, on the other hand, will lose weight, become weak, and be more subject to disease than one that is adequately fed.

Oats, the standard grain for horses, can be fed safely to all classes. Owing to the fibrous hull around it, the grain forms a loose mass in the stomach which is easily digested and less apt to cause colic than the heavier grains, such as wheat, corn, or even barley. Oats may be fed either as the sole component of the concentrate ration or in combination with other concentrate feeds.

Barley is somewhat less bulky than oats, but it too may be used either as all or as only a part of the grain ration. It is a small, hard grain and should be fed only when rolled, steamed, soaked, or ground.

Corn is a concentrated feed less bulky and higher in energy than either oats or barley. It is more suitable for working animals than for brood mares or growing foals. If used for breeding or growing stock, it should be fed in combination with other feeds which are relatively high in protein. Legume hays are excellent feeds to overcome the deficiency of protein and minerals in corn.

Wheat bran is a bulky, protein-rich concentrate having laxative properties. Fed in limited quantities, it is very valuable in the rations for all classes of horses. If used daily, the amount probably should not exceed 10 or 15 percent of the weight of the concentrate allowance.

Linseed meal, soybean meal, and *peanut meal* are suitable protein concentrates for feeding to horses in limited quantities. Linseed meal is considered by some feeders to have certain tonic properties and is often used in fitting horses for spring work or for showing.

Timothy hay is a popular roughage, especially for light horses, partly because it is palatable and partly because it is less likely to be dusty or moldy than many other hays. It is relatively low in

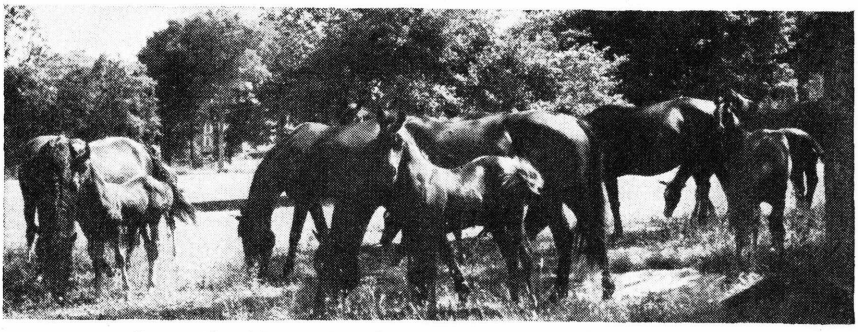

Figure 15.—Morgan brood mares, with their foals, on pasture.

protein and minerals, however, and is best fed in combination either with a daily allowance of a good legume hay or with a protein-rich concentrate.

Legume hays are especially valuable for brood mares and growing stock because of their relatively high content of proteins and minerals. However, their unlimited use is reported sometimes to result in softness, excessive sweating, and digestive disturbances; hence it may be advisable to limit the amount fed to 1 pound or less to 100 pounds of body weight. Bright, well-cured, mixed hays such as timothy and clover make excellent roughages for horses.

Pastures provide valuable and appetizing feed for horses whether idle or working. Pasturage alone does not furnish sufficient feed for horses at work; it should be supplemented with hay and a grain or concentrate mixture, relatively high in protein. Pasturage is ideal for mares and foals (fig. 15).

Silage for Horses

Good corn silage may be fed to idle horses in limited quantities as a supplement to the regular ration. Silage acts as an appetizer and a tonic, and may be supplied in quantities not to exceed 10 to 15 pounds daily an animal with good results, but it should be introduced into the ration gradually. Never feed moldy or frozen silage to horses.

Watering Horses

A horse requires 10 to 12 gallons of water daily. If it has not had water for several hours and has been at hard work, it should be watered before being fed. To allow a horse to drink freely while warm is dangerous, but a small drink taken slowly will do no harm. During hot weather, let working horses drink in the midforenoon and midafternoon or oftener if satisfactory arrangements can be made. Horses should have water after their evening feed. This can be most readily provided by turning them out for the night on pasture where there is a supply of good water.

Salt for Horses

Salt should be available to horses at all times when they are not working. Their great relish for salt shows their need of it. It is best to give salt separately from the feed. During warm weather when horses are at hard work, they will need more salt than at other times to replace that lost in sweat. A horse will consume from ½ to 2 ounces of salt daily. In areas where goiter is frequent, use iodized salt, especially for brood mares, stallions, and colts.

Care of Horses' Teeth

The most careful feeding may not keep a horse in good condition if its teeth are not sound and even, thereby permitting proper chewing of its feed. Sometimes the first, or milk, teeth of young horses remain longer than they should, causing the permanent teeth to grow crooked. Watch for this condition and remove the milk teeth with forceps if it develops. If a horse's teeth wear irregularly, so that proper chewing is impossible, remove the irregularities (fig. 16).

Feeding Light Horses

Horses of the light breeds that are used for driving, riding, or racing are fed to produce action, spirit, and endurance.

Large paunchy stomachs are objectionable. Give light horses somewhat more grain and less hay in proportion to the weight than draft horses. Oats easily rank first in popularity among the grains. Crushed or rolled barley and wheat bran are good supplementary feeds. Corn alone is too concentrated, but may be fed to advantage with oats and wheat bran or linseed meal. The best

roughage is a high-quality hay, consisting of mixed grasses and legumes. A mixture of alfalfa or clover hay with timothy is good.

Feeding Work Horses

The quantity of feed for the work horse depends on the work and on the speed at which it is performed. A horse requires more feed when working at a trot than at a walk. The following are general guides for the daily ration under usual conditions of work:

Figure 16.—A veterinarian examines horse's teeth to be sure there are no rough or uneven places that will interfere with chewing.

Allow about ½ pound of grain and 1 to 1½ pounds of hay to 100 pounds of live weight for horses at light work.

Allow 1 pound of grain and 1 to 1¼ pounds of hay to 100 pounds of weight for a horse at moderate work.

Allow 1¼ to 1⅓ pounds of grain and 1 pound of hay to 100 pounds of weight for a horse at hard work.

If roughage feeds become scarce or expensive, horses can be kept either idle or at work on rations supplying as little as ½ pound of hay to 100 pounds of body weight if the grain allowance is properly adjusted.

As shown in the following suggested rations for horses, the kinds of grain and hay govern the quantities used:

RATIONS FOR 1,000-POUND HORSE

RATION 1	*Pounds*	RATION 2	*Pounds*
Ear corn	5	Cowpea hay	5
Alfalfa or clover hay	3	Corn silage	5
Corn stover	9	Timothy hay	10

RATIONS FOR 1,000-POUND HORSE AT VERY LIGHT WORK

RATION 3	*Pounds*	RATION 4	*Pounds*
Oats	6	Cowpeas (cracked)	3
Alfalfa or clover hay	4	Molasses	3
Timothy hay	9	Oat straw	13

RATIONS FOR 1,000-POUND HORSE AT MODERATE WORK

RATION 5	Pounds	RATION 6	Pounds
Ear corn	10	Shelled corn	10
Alfalfa or clover hay	5	Cowpea hay	6
Timothy hay	6	Corn stover	6

RATIONS FOR 1,000-POUND HORSE AT HARD WORK

RATION 7	Pounds	RATION 8	Pounds
Corn and oats	11	Rolled barley	10
Wheat bran	2	Gluten meal	3
Timothy hay	6	Alfalfa or clover hay	6
Clover or alfalfa hay	4	Prairie hay	4

Feeding Brood Mares

If possible, brood mares should be kept working up to within about a week of foaling, but heavy work should be avoided as this time approaches.

Never feed dusty, moldy, or decayed feed. The hay, especially during the latter part of gestation, should be bright and of good green color. No old hay should be fed unless it is supplemented with some good bright legume hay. Supply feeds containing plenty of protein, calcium, and phosphorus. Add wheat bran, linseed meal, or other laxative feeds to the ration to keep the mare's digestive tract active. A few days before foaling, decrease the grain allowance, and give plenty of laxative feeds.

A small feed of wheat bran is good for the first meal after foaling, followed by light rations for several days.

Within a week the mare may be turned on pasture and at the end of 2 weeks she may be gradually returned to a full ration and put at light work.

Feeding Foals

It is important that the foal get a good start with plenty of milk from the mare. Allow the foal to nurse at frequent intervals, even if the mare is working. If the mare is warm she should first be allowed to cool off. If good pasturage is not available, or if the grass becomes short, give the mare feed rich in protein, vitamins, and minerals, such as alfalfa or mixed timothy and clover hay and protein-rich concentrates.

When 3 to 5 weeks old, the foal should be given some grain. A good mixture is 2 parts of wheat bran, 6 parts of crushed oats, and 1 part of linseed meal. As soon as it will eat hay, provide some good leafy legume hay.

Provide plenty of clean, fresh water for both mare and foal.

Foals, once stunted, never fully recover. Remember that foals get more than half their full growth the first year.

Feeding Orphan Foals

If the mare dies, the foal may be raised on cow's milk if care is taken. However, for the first 24 hours the foal should be given the colostrum, if not from its dam then from another fresh mare. Keep the following points in mind:

Milk of low fat content from a fresh cow is the best kind of cow's milk. Skim milk with cream added in the proportion of 1½ tablespoonfuls to a pint may be used.

One tablespoonful of sugar and from 3 to 5 tablespoonfuls of limewater should be added to each pint of milk while the foal is very young.

Warm milk to blood heat before feeding and give ½ pint every 2 hours for the first day.

After the first day, the time between feedings may be gradually increased to 4 hours, and the total quantity of milk increased. Until the foal begins eating supplementary feeds, 4½ to 6 quarts of milk for each 100 pounds of body weight will probably be required.

Begin feeding grain and hay as soon as possible and keep the foal on pasture as long as grazing is available.

Weaning Foals

In general, the foal should be weaned at the age of 6 months and separated from the mare at that time. Having several foals together in the same lot keeps them contented. Although the feeding should be liberal, particularly at weaning time, the quantities of grain and hay to be fed will depend on the pasturage available.

Feeding Young Horses

The period from weaning through the third year is most important in the development of the young horse. The foal should be under constant observation to see that it grows steadily. Shelter from extreme weather conditions should be provided and supplies of good water and salt should be available at all times. The diet should consist of a good roughage, either pasture or hay, and a grain mixture which will promote good growth.

Oats and corn are suitable for feeding the young horse. Wheat bran, gluten feed, and linseed meal may be used to increase the protein in the diet. The following grain mixtures are satisfactory:

GRAIN MIXTURES FOR YOUNG HORSES

MIXTURE 1	*Parts by weight*	MIXTURE 2	*Parts by weight*
Corn	2	Oats	4
Oats	5	Corn	1
Wheat bran	1	Wheat bran	1
Linseed meal	1		

Increase the grain allowance as the foal grows. Usually not more than 1 pound of grain to 100 pounds of live weight is required up to the age of 2 years. In addition to the grain, the foal needs a liberal supply of roughage. When available, good pasture is best; otherwise, a well-cured hay should be fed. Clover, timothy, or alfalfa hay may be fed. Timothy hay is popular. Clover and alfalfa hay are relatively high in protein and may be supplemented by roughages of lower protein content, such as timothy hay or corn fodder.

Feeding the Stallion

Depending on his use for service and the amount of exercise, the stallion should receive about the same quantities of feed as a horse doing moderate work. Adequate exercise is very important to the stallion's well-being. Where this exercise is in the form of moderate work, the keep of a work horse can be saved.

Feeding Mules

Mules need about the same quantities and kinds of feed as horses. There is some evidence that a mule, for the same amount of feed, will do more work than a horse. Furthermore, mules often will eat some feeds, such as the coarser roughages, which horses refuse. As they are much less likely to overeat than horses, mules often are given free access to a feeder filled with corn or other concentrate feed.

Handy Information and Reference Tables

Common Feeds and Their Substitutes

The following tabulation indicates feedstuffs which may usually be substituted in livestock rations for some of the most common feeds (quantities depending on relative feeding values):

Feed:	*Feeds that may be substituted*
Whole milk	Skim milk supplemented with ground grains for older animals. Buttermilk and whey may be given to mature animals. The dam's milk or cow's milk, properly modified, is best for very young animals. Dried skim milk or dried buttermilk may be used also.
Corn	Barley, kafir, milo, sorghum, oats, buckwheat, rice, or similar feeds rich in carbohydrates and fats.
Oats	Bran, coarse middlings, distillers' dried grains, brewers' dried grains, or feeds having similar physical and nutritive qualities.
Wheat bran	Ground oats, other bran, distillers' dried grains, coarse middlings, alfalfa meal, or feeds having similar nutritive and physical qualities.
Linseed meal	Peanut meal, corn gluten feed, copra meal, cottonseed meal (for some animals), velvetbean meal, soybean meal, or similar feeds high in protein and mineral matter.
Cottonseed meal	Cottonseed cake, linseed meal, peanut meal, corn gluten meal, copra meal, velvetbean meal, soybean meal, or similar feeds high in protein and mineral matter.
Tankage	Fish meal, shrimp bran, meat scrap, or similar feeds high in protein and mineral matter.
Corn silage	Sorghum silage, other silage, pasture, roots, and green forage crops, or similar feeds.
Pasture	Silage, good-quality green hay, roots, or forage crops as supplements. (There is no practical substitute for pasture in most sections if economy is considered.)
Clover hay	Other legume hays, such as alfalfa, lespedeza, peanut, soybean, cowpea, or velvetbean hay.
Timothy hay	Other grass hays, mixed hays, oats, wheat, or other grain hay, or similar roughages.
Corn stover	Other stovers, grass hays, oat straw, or similar roughages.
Oats straw	Corn stover, other stovers, barley straw and other straws, cottonseed hulls, and similar feeds.

Weights and Measures of Common Feeds

In calculating rations and mixing concentrates it is usually necessary to use weights rather than measures. However, in feeding livestock it is often more convenient for the farmer to measure the concentrates. The following tabulation will serve as a guide in feeding by measure:

Feed:	*Approximate weight* *Lbs. per quart*	*Lbs. per bushel*
Alfalfa meal	0.6	19
Barley	1.5	48
Beet pulp (dried)	.6	19
Brewers' grain (dried)	.6	19
Buckwheat	1.6	50
Buckwheat bran	1.0	29
Corn, husked ear	--	70
Corn, cracked	1.6	50
Corn, shelled	1.8	56
Corn meal	1.6	50
Corn-and-cob meal	1.4	45
Cottonseed meal	1.5	48
Cowpeas	1.9	60
Distillers' grain (dried)	.6	19
Fish meal	1.0	35
Gluten feed	1.3	42
Linseed meal (old process)	1.1	35
Linseed meal (new process)	.9	29
Meat scrap	1.3	42
Molasses feed	.8	26
Oats	1.0	32
Oats, ground	.7	22
Oat middlings	1.5	48
Peanut meal	1.0	32
Rice bran	.8	26
Rye	1.7	56
Soybeans	1.8	60
Soybean meal	1.3	51
Tankage	1.6	51
Velvetbeans, shelled	1.8	60
Wheat	1.9	60
Wheat bran	.5	16
Wheat middlings, standard	.8	26
Wheat screenings	1.0	32

Feeding Terms

Balanced Ration.—A ration which contains nutrients of all essential kinds in quantities sufficient for the performance, with greatest efficiency, of the function for which it is fed.

Carbohydrates and fat.—Nutrients which produce fat, heat, and power to do work when consumed by animals. Fat is about 2¼ times as valuable in producing heat and power as carbohydrates. Feeds containing large quantities of starch and sugar are rich in carbohydrates; oily feeds contain large quantities of fat.

Concentrates.—Grains, linseed meal, tankage, and other by-products which supply a large proportion of digestible nutrients per unit weight.

Crude fiber.—The coarse, fibrous portions of plants, composed largely of carbohydrates, which are less digestible than others.

Legumes.—Plants, such as clover, alfalfa, cowpeas, and soybeans, which have on their roots nodules containing bacteria cap-

able of taking nitrogen from the air and making it available to the plants. Legumes are generally richer in protein and minerals than other roughages.

Minerals.—Nutrients used by the animal in building its skeleton and for other special purposes. Legume hays, bran, linseed meal, cottonseed meal, meat scrap, tankage, and other feeds contain relatively large quantities of minerals. Ground limestone is a good source of calcium; bone meal is a good source of calcium and phosphorus.

Nutrients.—Substances in feeds which nourish animals.

Proteins.—The name given to a class of nutrients that contain nitrogen and are used chiefly for the growth and maintenance of the animal body. Lean meat, skim milk, wheat bran, linseed meal, cottonseed meal, fish meal, meat scrap, and tankage are some of the feeds which contain relatively large quantities of protein.

Ration.—The quantity of feed given an animal in any period of time, usually one day.

Roughages.—Feeds such as pasturage, hay, straws, roots, and silage which are coarse and bulky.

Soiling crop.—Any growing crops which are cut and fed to animals in a fresh condition.

Vitamins.—Substances present in feeds in very small quantities, which are necessary for growth, reproduction, and protection against certain diseases.

Protein in Livestock Feeds

As most American farm-grown feeds contain an excess of carbohydrates and have a scarcity of protein, the percentage of protein in feeds that have to be bought is one of the best measures of the value of such feeds. The following tabulations classify some of the most common roughages and concentrates according to their approximate protein content. They will be a good guide in buying feeds and be of help in planning rations where it is necessary to know the approximate quantity of protein contained in the various components of the ration.

The digestible protein contents of the common roughages and concentrates are as follows:

LOW-PROTEIN ROUGHAGES

About 1 percent:
- Rye straw.
- Wheat straw.
- Oat straw.

About 3 percent:
- Corn fodder.
- Corn stover.
- Canada bluegrass hay.
- Clover straw.
- Cowpea straw.
- Soybean straw.
- Meadow fescue hay.
- Rye hay.
- Timothy hay.

About 5 percent:
- Buckwheat straw.
- Clover and timothy hay.
- Barley hay.
- Kafir fodder.
- Kentucky bluegrass hay.
- Millet hay.
- Mixed grass hay.
- Oat hay.
- Orchard grass hay.
- Prairie hay.
- Redtop hay.
- Sweet corn fodder.
- Wheat hay.

HIGH-PROTEIN ROUGHAGES

About 7 percent:
Alsike clover hay.
Emmer hay.
Native western bluegrass hay.
Peanut vine (without nuts).
Red clover hay.
Vetch and oats hay.

About 9 percent:
Alfalfa hay (first cutting).
Crimson clover hay.
Lespedeza hay.
Peas and oats hay.

About 11 percent:
Alfalfa hay (second cutting).
Alfalfa meal.
Red clover hay (before bloom).
Sweet clover hay.
Soybean hay.
Vetch hay (common vetch).

About 13 percent:
Cowpea hay.
Canadian field pea hay.
Velvetbean hay.

About 15 percent:
Alfalfa hay (before bloom).
Alfalfa leaves.
Hairy vetch hay.

COMMON CONCENTRATES

About 5 percent:
Beet pulp (dry).
Buttermilk.
Corn-and-cob meal.
Corn meal.
Hominy feed.
Skim milk.

About 10 percent:
Barley.
Kafir grain.
Oats.
Rice polish.
Rye.
Sorghums, ground.

About 15 percent:
Oatmeal.
Red dog flour.
Sunflower seed (with hulls).
Velvetbean meal (pods included).
Wheat bran.
Wheat middlings.

About 20 percent:
Brewers' grain (dry).
Cocoanut meal.
Cowpeas.
Distillers' grains (dried).
Gluten feed.
Distillers' solubles (dried).
Fresh-ground bone.
Peanut meal (with hulls).

About 25 percent:
Buckwheat middlings.
Gluten meal (low grade).

About 30 percent:
Linseed meal.
Soybeans.

About 35 percent:
Gluten meal (high grade).
Cottonseed meal.
Meat and bone meal.

About 40 percent:
Peanut meal (without hulls).
Soybean cake meal (fat extracted).

About 45 percent:
Peanut cake (from hulled nuts).

About 45 percent:
Tankage containing from 40 to 60 percent protein, depending on method of manufacture. (The guaranty tag states the protein content of tankage).
Fish meal, with about the same protein content as tankage.
Dried blood, which may contain as much as 80 percent protein.

Size and Capacity of Silos

The diameter of the silo should depend on the quantity of silage to be fed daily; the height, on the length of the feeding season. Hence, before constructing a silo the farmer should know approximately (1) the number of animals he intends to feed, (2) the quantity of silage to be fed daily, and (3) the number of days silage is to be fed.

In general, the height of the silo should not be less than twice nor more than three times the diameter. The diameter should be small enough to allow the removal of enough silage from the entire surface each day to prevent spoiling. When the weather is cold, feeding may be as slow as desired; in summer 3 inches or more

should be removed daily. Table 1 shows the sizes of silos required for winter and summer with herds of different sizes when fed at rates ranging from 20 to 50 pounds an animal a day.

TABLE 1.—*Size of silo required for different sized herds of cattle when fed at various rates*

Number of animals	Quantity fed per animal daily	For winter-feeding period of 200 days		For summer-feeding period of 100 days	
		Total needed	Diameter and height of silo (inside measurements)	Total needed	Diameter and height of silo (inside measurements)
	Pounds	*Tons*	*Feet*	*Tons*	*Feet*
5	30	15	8 by 18	--------	----------
5	40	20	8 by 22	--------	----------
5	50	25	8 by 26	--------	----------
10	20	20	8 by 22	10	(1)
10	30	30	10 by 22	15	[2] 8 by 18
10	40	40	10 by 28	20	[2] 8 by 22
10	50	50	10 by 32 12 by 24	25	8 by 26
20	20	40	10 by 28	20	[2] 8 by 22
20	30	60	12 by 28	30	[2] 10 by 22
20	40	80	12 by 36 14 by 28	40	10 by 28
20	50	100	14 by 34	50	10 by 32 12 by 24
30	20	60	12 by 28	30	[2] 10 by 22
30	30	90	14 by 30	45	10 by 30
30	40	120	14 by 40 16 by 32	60	12 by 28
30	50	150	16 by 38	75	12 by 34
40	20	80	12 by 36 14 by 28	40	10 by 28
40	30	120	14 by 40 16 by 32	60	12 by 28
40	40	160	16 by 40	80	12 by 36 14 by 28
40	50	200	16 by 48 18 by 40	100	14 by 34
50	20	100	14 by 34	50	10 by 32 12 by 24
50	30	150	16 by 38	75	12 by 34
50	40	200	16 by 48 18 by 40	100	14 by 34
50	50	250	18 by 48	125	14 by 40 16 by 32

[1] A silo that would hold only 10 tons or less would be too small to be practicable.
[2] Too low to permit 3 inches to be removed daily; removal of less than 3 inches daily is not practicable for summer feeding.

The silage required in summer will be only about half that required in winter. If the silage for both seasons is to be made at one time and the herd is not so large as to require more than two silos, the silo for summer use should be smaller than the one for winter use. But if the silage to be fed in the summer is made in the spring and that to be fed in the winter is made in the fall, the two silos can be the same size; both would be filled in the fall and only one in the spring.

Determining Quantity of Hay in Rick

Generally, 512 cubic feet of hay in a stack or mow weighs 1 ton. To determine with reasonable accuracy the number of tons of hay in a rick of average shape, multiply the distance over the stack—that is, the distance from the ground on one side to the ground on the other—by the width, then the length, and then by 0.37. This will give the number of cubic feet. Divide this number by 512 to get the number of tons in the stack.

Composition of Feedstuffs

Analyses of the principal feedstuffs used in feeding farm animals show the percentage composition of each as given in table 2.

TABLE 2.—*Composition of feedstuffs used in animal feeding*

GRAINS, SEEDS, AND MILL CONCENTRATES

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Barley	9.6	2.9	12.8	2.3	5.5	66.9	0.07	0.32
Barley feed	7.9	4.9	15.0	4.0	13.7	54.5	.03	.41
Bread, kiln dried	10.5	2.1	12.5	1.6	.4	72.9	.03	.12
Brewers' dried grains:								
18–23 percent protein	7.9	4.1	20.7	7.2	17.6	42.5	.16	.47
23–28 percent protein	7.7	4.3	25.4	6.3	16.0	40.3	.16	.47
Brewers' rice	11.6	.7	7.0	.8	.6	79.3	.03	.25
Buckwheat	12.6	2.0	10.0	2.2	8.7	64.5	.06	.43
Buckwheat middlings	12.4	4.6	28.0	6.6	5.3	43.1	----	----
Cocoa shells	9.2	8.2	16.4	5.4	15.8	45.0	----	----
Cocoanut cake	10.7	4.0	19.1	11.0	14.1	41.1	.25	.62
Cocoanut meal, old process	7.3	5.5	21.3	10.0	9.4	46.5	.28	.58
Cocoanut meal, new process	8.9	6.6	21.4	2.4	13.3	47.4	.28	.58
Corn, shelled	12.9	1.3	9.3	4.3	1.9	70.3	.01	.26
Corn bran	10.0	2.1	10.0	6.6	8.8	62.5	.03	.14
Corn chop	11.3	1.4	9.8	4.1	2.1	71.3	.01	.26
Corn (ear) chop	10.7	2.0	8.2	3.4	9.2	66.5	.01	.25
Corn feed meal	10.8	1.9	10.5	5.3	2.9	68.6	.04	.38
Corn germ meal	7.0	3.8	20.8	9.6	7.3	51.5	.05	.59
Corn gluten feed	9.5	6.0	27.6	3.0	7.5	46.4	.11	.78
Corn gluten meal	8.0	2.2	43.0	2.7	3.7	40.4	.10	.47
Corn oil meal	8.7	2.2	22.1	6.8	10.8	49.4	.06	.62
Cottonseed, whole pressed	6.5	4.3	29.6	5.8	25.1	28.7	.15	.77
Cottonseed cake	7.5	5.9	44.1	6.4	10.3	25.8	.20	1.03
Cottonseed feed, 32 percent protein	8.3	4.8	32.1	6.4	15.3	33.1	.20	.73
Cottonseed hulls	8.7	2.6	3.5	1.0	46.2	38.0	.15	.10
Cottonseed meal:								
33–38 percent protein	7.4	5.2	36.6	5.6	15.3	29.9	.28	1.30
38–43 percent protein	7.3	6.1	41.0	6.5	11.9	27.2	.19	1.11
43–48 percent protein (exp.-hyd.)	7.0	5.8	43.9	6.6	10.5	26.2	.20	1.03
43–48 percent protein (solv.)	8.1	5.5	43.7	1.9	11.9	28.9	----	----
Cowpeas	11.1	3.5	23.5	1.5	4.1	56.3	.10	.46

[1] Fat.

[2] Carbohydrates except fiber.

[3] Leaders indicate that data are lacking.

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

GRAINS, SEEDS, AND MILL CONCENTRATES—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Distillers' dried grain:								
Corn	6.0	2.4	27.6	8.7	12.5	42.8	.10	.45
Milo	6.9	1.6	40.8	13.1	11.8	25.8	------	-----
Rye	6.5	2.3	20.9	6.4	14.4	49.5	------	-----
Wheat	7.0	2.2	30.4	6.6	13.4	40.4	.06	.42
Distillers' dried grains with solubles:								
Corn	7.3	3.8	29.1	9.0	9.5	41.3	.14	.75
Milo	4.2	3.7	32.8	9.7	12.1	37.5	------	-----
Wheat	7.4	4.8	32.9	5.6	9.4	39.9	.15	.68
Distillers' dried solubles:								
Corn	7.2	7.5	27.4	7.6	4.3	46.0	.40	1.30
Milo	6.9	7.7	29.4	5.9	3.5	46.6	------	-----
Rye	6.5	7.8	35.5	.6	2.4	47.2	------	-----
Wheat	7.5	8.0	30.1	2.0	8.0	50.4	.35	1.51
Feterita	9.1	1.7	14.2	2.9	1.4	70.7	.02	.32
Field peas	9.3	3.3	23.3	1.2	5.9	57.0	.08	.40
Fermentation solubles:								
Grain	7.3	6.2	35.8	6.2	8.1	36.4	------	-----
Molasses	4.5	12.6	28.0	1.2	1.8	51.9	------	-----
Hemp cake	10.8	18.0	30.8	10.2	22.6	7.6	.22	.87
Hempseed, European	8.8	18.8	21.5	30.4	15.9	4.6	------	-----
Hominy feed	9.5	2.9	11.2	8.3	6.3	61.8	.03	.44
Kafir	11.9	1.7	11.1	3.0	2.3	70.0	.01	.25
Kafir head chops	10.4	3.9	10.9	2.5	6.0	66.3	.09	.20
Linseed meal:								
33–38 percent protein	8.5	5.6	35.3	5.4	8.3	36.9	.36	.84
38–43 percent protein	8.5	5.3	40.4	5.8	7.5	32.5	.33	.74
Malt	7.7	2.9	12.4	2.1	6.0	68.9	------	-----
Malt sprouts	7.3	6.1	28.1	1.8	13.3	43.4	.26	.68
Mesquite beans and pods	6.6	4.5	13.0	2.7	22.8	50.4	------	-----
Millet, foxtail	10.1	3.3	12.6	4.3	8.4	61.3	------	-----
Millet, proso or hog millet	9.8	3.4	12.0	3.4	7.9	63.5	.01	.33
Milo	9.3	1.6	12.5	3.2	1.5	71.9	.04	.32
Milo head chop	10.4	4.3	10.7	2.6	7.1	64.9	.14	.26
Molasses, beet	20.5	9.1	9.7	------	------	60.8	.30	.04
Molasses, cane	24.0	6.8	3.1	------	------	66.1	.35	.06
Molasses, corn sugar	19.5	2.5	.2	.0	------	77.8	.50	.05
Molasses, wood sugar	40.0	3.4	.6	.8	------	55.2	1.00	.12
Oats, grain	7.7	3.5	12.5	4.4	11.2	60.7	.10	.40
Oat chop	8.9	3.9	12.8	5.0	11.8	57.6	.10	.36
Oat clips	9.0	9.3	11.8	4.5	22.7	42.7	------	-----
Oat groats, ground rolled	10.4	2.6	17.3	6.6	1.8	61.3	.08	.43
Oat hulls	5.8	6.5	4.3	1.9	30.8	50.7	.09	.12
Oatmeal	8.9	2.3	16.5	4.8	3.6	63.9	.08	.43
Oat millfeed	6.9	6.0	6.3	2.2	27.9	50.7	.20	.22
Palm kernel	8.4	1.8	8.4	48.8	5.8	26.8	------	-----
Palm kernel cake	10.1	3.9	16.2	11.0	21.4	37.4	------	-----
Peanut kernels	5.5	2.3	30.2	47.6	2.8	11.6	.06	.38
Peanuts, shell on	6.0	2.8	24.7	33.1	18.0	15.4	------	-----

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

GRAINS, SEEDS, AND MILL CONCENTRATES—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Peanut meal:								
38–43 percent protein	6.4	4.4	41.6	7.2	16.0	24.4	0.10	0.50
43–48 percent protein	6.7	4.6	45.0	7.2	14.2	22.2	.17	.55
Over 48 percent protein	7.0	5.0	51.4	4.8	9.2	22.6	-----	-----
Rapeseed, brown Indian	5.7	6.4	21.0	41.2	12.5	13.2	-----	-----
Rapeseed, common	7.3	4.2	19.5	45.0	6.0	18.0	-----	-----
Rice, rough	9.7	5.4	7.3	2.0	8.6	67.0	.10	.10
Rice bran	8.8	12.2	12.8	13.8	12.2	40.2	.10	1.84
Rice hulls	6.5	21.9	2.1	.4	44.8	24.3	.08	.06
Rice polish	10.0	7.6	12.4	13.2	2.8	54.0	.03	1.52
Rice stone bran	8.4	11.9	12.5	13.0	11.1	43.1	-----	-----
Rye	9.5	1.9	11.1	1.7	2.1	73.7	.04	.37
Rye feed	10.2	4.0	15.6	3.2	4.3	62.7	.07	.59
Rye middlings	9.5	4.4	16.7	3.7	5.5	60.2	-----	-----
Safflower meal	6.9	6.3	28.8	6.5	28.7	22.8	-----	-----
Sesame seed	5.5	6.5	20.3	45.6	7.1	15.0	-----	-----
Sesame seed cake	9.8	10.7	37.5	14.0	6.3	21.7	2.37	1.21
Sorghum gluten feed	9.1	7.3	25.2	3.8	7.1	47.5	-----	-----
Sorghum gluten meal	8.6	2.5	41.0	4.9	3.3	39.7	-----	-----
Sorgo	12.8	2.1	9.1	3.6	2.6	69.8	-----	-----
Soybeans	8.0	4.8	38.9	18.0	4.8	25.5	.22	.67
Soybean meal:								
38–43 percent protein (exp.-hyd.)	7.8	5.7	42.0	6.0	6.1	32.4	.24	.63
43–48 percent protein (exp.-hyd.)	8.2	5.9	44.4	5.7	6.0	29.8	.26	.62
43–48 percent protein (solv.)	8.7	6.0	46.0	1.1	5.7	32.5	.25	.68
Sunflower seed	6.9	3.2	15.2	28.8	28.5	17.4	.41	.99
Sunflower hulls	10.5	2.6	4.4	3.4	57.0	22.1	-----	-----
Sunflower kernels	6.9	4.2	29.4	43.9	2.6	13.0	-----	-----
Velvetbeans	9.8	3.1	26.2	4.8	6.0	50.1	.14	.40
Vinegar grains	6.8	2.9	19.5	7.0	17.3	46.5	-----	-----
Wheat	10.6	1.8	12.0	2.0	2.0	71.6	.05	.38
Wheat bran	9.4	6.4	16.4	4.4	9.9	53.5	.10	1.14
Wheat, brown shorts	10.8	4.0	17.8	4.8	5.8	56.8	-----	-----
Wheat flour middlings	10.4	3.3	18.8	4.0	4.2	59.3	.09	.80
Wheat, gray shorts	11.0	4.1	17.5	4.4	5.4	57.0	.08	.86
Wheat, mixed feed	9.9	4.4	18.2	4.4	6.9	56.1	.11	.96
Wheat, red dog	11.1	2.2	18.3	3.4	2.3	62.7	.12	.83
Wheat standard middlings	10.4	3.9	17.0	4.3	5.4	59.0	.09	.90
Wheat, white shorts	10.9	2.2	15.6	3.7	2.4	65.2	.12	.56
Wheat waste, shredded	8.0	1.6	12.4	1.6	2.6	73.8	-----	-----
Yeast, brewers' dried	5.5	7.3	47.2	.9	3.0	36.1	.11	1.52
Yeast cells, dried	4.3	10.7	48.5	.5	.5	35.5	.42	1.90
Yeast dried feed	6.0	7.7	52.6	4.3	17.2	12.2	.07	1.55

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

ANIMAL, MARINE, AND MILK PRODUCTS

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Beef meal	8.0	13.0	70.6	9.1	0	0	------	------
Blood meal	8.8	5.3	83.1	1.1	.8	.9	.28	.22
Bone, green, horse	59.0	20.4	19.2	.4	0	0	------	------
Bone, green, butchershop	52.0	16.3	16.6	17.0	0	0	------	------
Bone meal, raw	6.7	62.1	25.2	3.3	1.4	1.3	24.20	11.5
Bone meal, steamed	3.1	83.6	6.2	2.2	1.3	3.6	30.00	13.9
Bone meal, special steamed	2.7	75.1	11.1	6.5	1.7	2.9	27.00	13.20
Buttermilk	91.0	.7	3.0	.5	------	4.8	.13	.09
Buttermilk, dried	5.5	9.4	34.3	7.0	.3	43.5	1.32	.93
Crab meal	8.4	37.1	37.9	3.1	8.4	5.1	------	------
Fish meal	7.1	17.7	62.0	7.3	.6	5.3	4.31	2.68
Fish meal, menhaden	7.1	25.7	57.8	6.2	2.4	.8	5.00	3.40
Fish meal, sardine	6.7	13.4	68.1	4.3	.5	7.0	4.73	2.63
Fish, whiting	71.0	5.4	18.8	4.0	1.7	0	------	------
Lips, ox	71.0	1.5	19.0	9.5	0	0	------	------
Liver, hog	72.8	------	19.8	5.3	0	0	.01	.45
Liver meal	7.3	8.0	65.2	14.9	1.9	2.7	.11	.90
Liver and glandular meal	6.5	4.7	65.1	16.5	1.5	5.7	------	------
Lungs, beef	79.7	1.0	16.1	3.2	0	0	------	------
Lungs, calf	76.8	1.1	16.1	5.0	0	0	------	------
Meat, horse muscle	75.0	1.1	20.2	2.9	0	0	------	------
Meat, beef muscle	72.0	1.0	21.2	5.2	0	0	0.1	.22
Meat and bone scrap:								
42–48 percent protein	5.8	28.9	45.6	14.0	2.4	3.3	9.63	5.00
48–53 percent protein	5.7	29.3	50.3	10.4	2.0	2.3	9.34	5.07
53–58 percent protein	6.5	25.1	55.5	9.1	2.2	1.6	8.28	4.04
Meat scrap:								
48–53 percent protein	6.4	26.0	50.8	10.4	3.2	3.2	7.80	4.17
53–58 percent protein	6.1	24.4	55.3	9.7	2.3	2.2	7.68	4.00
58–63 percent protein	7.2	19.8	60.0	9.6	2.3	1.1	5.72	3.02
Melts, beef	75.0	1.5	19.0	2.0	0	0	------	------
Melts, pork	78.0	1.5	17.5	2.0	0	0	------	------
Milk, skim	91.1	.8	3.4	.2	0	4.5	.13	.10
Milk, skim, dried	4.7	8.8	35.8	1.0	.1	49.6	1.34	.99
Milk, whole	87.1	.7	3.6	3.7	0	4.9	.12	.09
Shrimp meal	10.7	33.4	38.5	2.6	11.7	3.1	7.71	1.31
Tankage, digester:								
53–58 percent protein	7.3	23.3	56.0	9.6	2.2	1.6	7.49	3.86
58–63 percent protein	6.3	20.7	60.3	9.1	2.0	1.6	6.37	3.28
Tankage, digester:								
53–58 percent protein	7.6	21.8	55.8	10.4	2.5	1.9	8.92	4.22
Over 58 percent protein	6.8	19.5	61.6	8.6	1.7	1.8	7.07	3.72
Tankage, digester, with bone:								
38–43 percent protein	6.4	32.4	40.0	14.1	3.0	4.1	------	------
43–48 percent protein	6.3	31.3	46.0	12.5	1.9	2.0	------	------
48–53 percent protein	5.8	28.6	51.2	10.4	1.6	2.4	10.97	5.14
Over 53 percent protein	6.2	24.2	54.5	10.3	1.7	3.1	9.24	4.15

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

ANIMAL, MARINE, AND MILK PRODUCTS—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Tripe, raw	86.5	.3	11.7	1.2	0	.3	------	-----
Viscera, horse (includes blood)	77.0	1.1	19.8	1.2	0	0	------	-----
Whey	93.8	.4	.6	.1	0	5.1	.04	.04
Whey, dried	6.7	10.1	12.8	.6	.2	69.6	.73	.66
GREEN FORAGES								
Alfalfa, immature	79.4	2.9	5.2	0.7	3.8	8.0	0.28	0.09
Alfalfa, in bloom	77.2	1.8	3.2	.6	7.8	9.4	.39	.07
Alsike clover, immature	81.2	2.4	4.9	.6	3.1	7.8	.26	.09
Alsike clover, in bloom	74.8	2.0	3.9	.9	7.4	11.0	.21	.06
Barley, immature	83.4	1.5	2.8	.7	3.6	8.0	.06	.07
Barley, mature	77.1	1.6	2.2	.5	6.4	12.2	.05	.07
Bluegrass, Kentucky, immature	70.5	2.5	5.0	1.2	7.5	13.3	.15	.13
Bromegrass, immature	77.5	2.9	4.3	.9	5.2	9.2	.14	.10
Cabbage	90.5	.9	2.4	.3	1.2	4.7	.06	.02
Canada bluegrass, immature	74.1	2.5	4.3	1.3	6.8	11.0	.11	.12
Corn fodder:								
Dent, immature	79.0	1.2	1.7	.5	5.6	12.0	------	-----
Dent, mature	73.4	1.5	2.0	.9	6.7	15.5	------	-----
Flint	77.1	1.5	2.0	.9	6.7	15.5	------	-----
Flint, immature	79.8	1.1	2.0	.7	4.3	12.1	------	-----
Flint, mature	77.1	1.1	2.1	.8	4.3	14.6	------	-----
Cowpeas	82.5	2.5	3.4	.5	4.0	7.1	.18	.05
Crimson clover	80.9	1.7	3.1	.7	5.2	8.4	.28	.04
Kafir	73.0	2.0	2.3	.7	6.9	15.1	------	----
Lespedeza, Korean, immature	74.1	2.4	4.6	.8	5.8	12.3	.34	.11
Meadow fescue, immature	78.8	2.6	4.0	.9	4.7	9.0	.15	.11
Meadow foxtail, immature	73.9	2.8	4.5	1.2	5.6	12.0	.15	.12
Millet, foxtail	71.1	1.7	3.1	.7	9.2	14.2	.09	.05
Oatgrass, tall, immature	78.4	3.0	4.3	1.0	4.6	8.7	.11	.13
Oats, immature	82.6	1.7	2.9	.7	3.3	8.8	.07	.07
Oats, mature	72.0	2.1	2.7	.9	7.4	14.9	.08	.08
Orchard grass, immature	78.3	2.8	3.4	1.0	5.3	9.2	.14	.13
Orchard grass, in bloom	73.0	2.0	2.6	.9	8.2	13.3	------	----
Prickly pear	78.9	4.3	.7	.4	2.6	13.1	------	----
Rape	85.7	2.0	2.4	.6	2.2	7.1	.34	.07
Red clover, immature	81.2	2.7	5.0	.8	3.0	7.3	.27	.10
Red clover in bloom	70.8	2.1	4.4	1.1	8.1	13.5	.44	.07
Red fescue, immature	70.5	2.8	4.1	.9	8.2	13.5	.16	.13
Red top, immature	76.8	2.8	4.1	.9	5.4	10.0	.15	.10
Reed canary grass, immature	80.7	2.4	3.5	.7	4.3	8.4	.13	.10
Rye, immature	80.8	2.3	4.5	1.1	3.4	7.9	.10	.10
Rye, mature	76.6	1.8	2.6	.6	11.6	6.8	.08	.06

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

GREEN FORAGES—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*cent Per*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Rye grass, Italian, immature	77.3	2.5	3.5	1.0	5.2	10.5	.13	.12
Rye grass, perennial, immature	75.0	3.0	3.8	.9	5.4	11.0	.15	.12
Sorgo	77.3	1.3	1.5	1.0	6.2	12.7	------	-----
Soybeans	73.9	2.9	4.0	1.1	7.6	10.5	.28	.05
Sweet clover	75.3	2.2	5.3	.7	6.7	9.8	.26	.07
Sweet corn	79.1	1.3	1.9	.5	4.4	12.8	------	-----
Timothy, immature	74.9	2.3	4.1	.9	5.4	12.4	.12	.11
Timothy, in bloom	61.6	2.1	3.1	1.2	11.8	20.2	.13	.05
Wheat, immature	82.3	2.1	3.8	.9	3.0	7.9	.07	.10
Wheat, mature	68.7	2.6	2.4	.7	8.6	17.0	.06	.08
White clover, immature	82.0	2.1	4.9	.6	3.1	7.3	.23	.09
White clover, wild, immature	81.2	2.2	5.2	.6	2.9	7.9	.25	.10

DRIED FORAGES

Alfalfa hay	7.2	8.0	15.4	1.6	30.3	37.5	1.15	0.21
Alfalfa leaf meal Sun cured	8.5	14.4	20.9	2.6	15.7	37.9	1.42	.25
Alfalfa leaf meal, dehydrated	8.1	11.4	21.0	3.3	19.1	37.1	------	-----
Alfalfa meal, dehydrated:								
15 percent protein	7.9	10.0	15.6	2.2	26.3	38.0	------	-----
17 percent protein	7.0	9.6	17.5	2.5	25.1	28.3	1.70	.22
20 percent protein	6.9	10.6	20.5	3.0	20.5	38.5	1.66	.31
Alfalfa meal, sun-cured:								
15 percent protein	8.2	10.0	15.0	2.2	27.5	36.9	1.56	0.22
17 percent protein	7.7	10.5	17.1	2.1	24.2	38.4	------	-----
Alfalfa stem meal	9.1	7.7	11.4	1.3	36.1	34.4	------	-----
Alsike clover hay	10.5	8.8	14.4	2.5	24.7	39.1	.78	.20
Australian saltbush hay	6.7	16.9	16.1	1.8	21.5	37.0	------	-----
Barley hay	15.0	6.4	6.7	1.6	21.4	48.9	.17	.25
Barley straw	14.2	5.7	3.5	1.5	36.0	39.1	------	-----
Bermuda grass hay	8.9	7.9	7.2	1.7	24.9	49.4	.60	0.16
Black grama hay	5.5	7.0	4.3	1.3	31.4	50.5	.22	.09
Blue grama hay	10.9	8.5	6.7	1.8	27.9	44.2	------	-----
Bluegrass hay, immature	7.3	7.9	15.2	3.0	23.7	42.9	.45	.35
Bluegrass hay, bloom	11.9	7.0	9.3	3.4	27.9	40.5	.30	.21
Bluejoint grass hay	7.5	6.9	6.7	3.0	34.2	41.7	------	-----
Bromegrass hay	14.0	9.7	9.3	1.8	26.6	38.6	------	-----
Buckwheat straw	9.9	5.5	5.2	1.3	43.0	35.1	------	-----
Buffalo grass hay	6.2	10.8	5.6	1.7	26.1	49.6	------	-----
Bur clover hay	8.7	12.3	15.7	3.0	25.5	34.8	1.11	.15
Corncobs	10.7	1.4	2.4	.5	30.1	54.9	------	-----
Corn fodder	11.8	5.8	7.4	2.4	23.0	49.6	.23	.15
Corn husks	9.8	2.9	2.9	.7	30.7	53.0	------	-----
Corn leaves	11.8	8.5	8.1	2.2	24.4	45.0	------	-----
Cornstalks	11.7	4.6	4.8	1.8	32.8	44.4	------	-----
Corn stover	10.7	6.1	5.7	1.5	30.3	45.7	.45	.10

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

DRIED FORAGES—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Cowpea	9.7	12.9	17.5	2.8	20.5	36.6	1.84	.25
Cowpea straw	9.7	5.3	7.4	1.3	41.5	34.8	------	-----
Crabgrass	9.0	7.9	6.5	2.2	32.1	42.3	.33	.17
Crimson clover hay	9.6	8.6	15.2	2.8	27.2	36.6	1.18	.13
Feterita fodder	13.3	6.4	8.7	1.9	21.5	48.2	.27	.10
Field pea hay	10.6	8.3	16.1	2.7	24.8	37.5	------	-----
Flax straw	6.2	3.8	7.8	2.1	46.9	33.2	------	-----
Hegari fodder	13.5	8.2	6.2	1.7	16.7	53.7	.17	.18
Hegari stover	15.1	9.7	4.5	1.9	26.6	42.2	.38	.09
Johnson grass hay	7.2	7.2	8.1	2.8	30.4	44.3	.55	.40
Kafir fodder	9.1	7.8	6.6	2.1	28.4	46.0	.31	.05
Kafir stover	12.6	9.0	5.8	1.7	27.5	43.4	------	-----
Lespedeza hay	7.9	6.2	11.9	2.8	28.5	42.7	.80	.25
Little bluestem hay	8.6	4.9	4.0	1.6	35.4	45.5	------	-----
Meadow fescue hay	11.6	7.0	6.6	2.0	31.6	41.2	------	-----
Millet hay, foxtail	7.0	8.2	9.2	2.8	28.0	44.8	.31	.30
Millet hay, pearl or cattail	10.1	9.7	9.0	1.8	32.3	37.1	------	-----
Natal grass hay	7.5	4.8	3.7	1.4	39.5	43.1	.49	.32
Oat hay	11.8	5.7	6.1	2.4	27.1	46.9	.27	.22
Oat straw	8.1	7.6	4.4	2.5	36.2	41.2	.23	.20
Oatgrass, tall, hay	8.1	6.4	9.4	2.7	29.8	43.6	------	-----
Orchard grass hay, immature	9.9	6.0	8.1	2.6	32.4	41.0	.31	.18
Orchard grass hay, mature	9.9	7.0	6.9	3.0	32.7	40.5	------	-----
Prairie hay (Colorado, Wyoming)	5.5	7.2	7.0	2.4	31.3	46.6	------	-----
Prairie hay (Kansas, Oklahoma)	9.5	7.5	4.4	2.3	30.4	45.9	.55	.07
Prairie hay (Minnesota, South Dakota)	11.6	7.2	6.0	2.4	30.3	42.5	.44	.11
Red clover hay	7.0	10.0	16.1	2.6	23.6	40.7	1.01	.14
Red clover, mammoth, hay	12.2	7.5	12.8	3.3	27.1	37.1	------	-----
Red top hay	8.9	5.2	7.9	1.9	28.6	47.5	.35	.18
Rhodes grass hay	8.6	8.4	5.3	1.2	33.4	43.1	------	-----
Rice straw	8.9	13.5	4.5	1.6	34.0	37.5	.18	.05
Rye hay	6.4	4.7	5.9	2.0	37.4	43.6	.27	.22
Rye straw	7.1	3.2	3.0	1.2	38.9	46.6	------	-----
Rye grass, perennial, hay	10.2	8.6	8.6	4.1	24.5	44.0	.17	.11
Rye grass, Italian, hay	8.5	6.9	7.5	1.7	30.5	44.9	------	-----
Rye grass hay	8.3	8.5	6.3	2.0	33.0	41.9	------	-----
Sedge, western species	5.4	6.7	11.6	2.4	27.4	46.5	------	-----
Slender wheatgrass	7.5	6.6	7.8	2.1	30.8	45.2	------	-----
Sorgo fodder	11.6	6.0	5.3	2.4	26.0	48.7	.27	.15
Sorgo hay	5.8	9.5	9.5	1.9	26.8	46.5	.31	.09
Soybean hay	8.4	8.9	15.8	3.8	24.3	38.8	1.26	.22
Soybean straw	8.7	7.4	5.7	2.5	34.6	41.1	------	-----
Sudan grass hay	5.3	8.1	9.7	1.7	27.9	47.3	.47	.24
Sweet clover hay	8.1	7.5	16.2	2.8	25.9	39.5	.74	.08
Sweet clover straw	5.1	3.4	6.7	1.2	49.6	34.0	------	-----
Vetch, hairy, hay	13.1	8.4	20.9	2.7	24.2	30.7	.25	.30

TABLE 2.—*Composition of feedstuffs used in animal feeding—Continued*

DRIED FORAGES—*Continued*

Feedstuff	Moisture	Ash	Crude protein	Ether extract [1]	Crude fiber	Nitrogen-free extract [2]	Calcium [3]	Phosphorus [3]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Western neddlegrass hay	9.9	6.2	5.5	2.7	33.2	42.5	------	-----
Western wheatgrass hay	8.6	8.7	8.4	2.3	31.9	40.1	------	-----
Wheat hay	9.6	4.2	3.4	1.3	38.1	43.4	.14	.15
Wheat straw	6.8	5.4	4.3	3.4	36.8	43.3	.29	.18
White clover hay	7.2	9.4	15.6	2.2	22.7	42.9	1.31	.28
Wire grass hay	8.5	7.3	6.6	1.3	34.6	41.7	------	-----
SILAGES, ROOTS, TUBERS, AND BYPRODUCTS								
Alfalfa silage	68.9	2.7	5.7	1.0	8.8	12.9	------	-----
Alfalfa-molasses silage	68.6	3.4	5.8	1.0	8.4	12.8	------	-----
Apple pomace	78.6	.6	1.3	1.2	3.7	14.6	0.02	0.01
Apple silage	87.6	.6	.7	.7	1.8	8.6	------	-----
Beet pulp, dried	9.2	3.2	9.3	.8	20.0	57.5	.66	.06
Beet pulp, molasses, dried	8.0	5.2	11.6	.7	16.4	58.1	.59	.09
Carrots	88.6	1.0	1.1	.4	1.3	7.6	.04	.04
Cassava	63.8	1.4	1.0	.3	.8	32.7	------	-----
Citrus pulp, dried	9.5	7.4	6.5	3.7	12.8	60.1	2.08	.11
Citrus pulp, molasses, dried	11.4	6.7	6.3	3.1	11.5	61.0	------	-----
Corn silage	73.8	1.7	2.1	0.8	6.3	15.3	.08	.08
Corn silage, immature	79.1	1.4	1.7	.8	6.0	11.0	.08	.06
Corn silage, mature	70.9	1.4	2.4	.9	6.9	17.5	------	-----
Corn stover silage	80.7	1.8	1.8	.6	5.6	9.5	------	-----
Cowpea silage	77.8	2.1	3.2	.9	6.5	9.5	------	-----
Hegari silage	66.3	3.4	2.3	.8	6.7	20.5	------	-----
Jerusalem artichokes	78.7	1.1	2.5	.2	.8	16.7	------	-----
Mangel-wurzel	90.8	1.0	1.4	.2	.9	5.7	.02	.02
Napier grass silage	67.5	1.8	1.2	.7	14.4	14.4	.10	.10
Parsnips	80.0	1.3	2.2	.4	1.3	14.8	.06	.08
Pea vine meal	8.0	8.1	13.5	3.2	22.5	44.7	------	-----
Pea vine silage	75.1	1.7	3.0	.9	8.1	11.2	------	-----
Potatoes	78.9	1.0	2.1	.1	.6	17.3	.01	.06
Potatoes, dried	10.8	4.4	8.8	.4	2.3	73.3	.08	.22
Red clover silage	72.0	2.6	4.2	1.2	8.4	11.6	------	-----
Rutabagas	88.6	1.2	1.2	.2	1.3	7.5	.05	.04
Sorgo silage	74.7	1.4	1.6	1.0	6.9	14.4	.09	.04
Soybean silage	75.6	2.6	2.4	.8	9.6	9.0	.29	.10
Sugar beets	78.0	1.0	1.5	.1	2.9	16.5	.05	.06
Sugar beet pulp	90.5	.4	.9	.2	2.2	5.8	------	-----
Sunflower silage	77.9	2.1	1.8	1.6	6.5	10.1	------	-----
Sweet clover silage	70.2	2.9	6.1	1.0	9.7	10.1	------	-----
Sweetpotatoes	71.1	1.0	1.5	.4	1.3	24.7	.02	.05
Sweetpotatoes, dried	9.1	4.2	3.6	.8	3.1	79.2	------	-----
Tomato pomace	6.3	4.8	27.0	13.2	25.8	22.9	------	-----
Turnips	90.6	.8	1.3	.2	1.2	5.9	.05	.05

TABLE 3.—*Concentrates for cow not on pasture*

Quantity of milk produced daily, with a butterfat percentage of—								Daily concentrate allowance, when good hay or its equivalent [1] is fed at the following rate per 100 pounds of body weight—			
3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	3 pounds of hay	2½ pounds of hay	2 pounds of hay	1½ pounds of hay
lb.	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*	*lb.*
10	9	7	7	6	5	4	4	0	0	1	4
12	11	10	9	7	7	6	6	0	0	2	5
15	14	12	11	9	9	8	7	0	0	3	6
19	17	15	13	11	11	9	8	0	1	4	7
21	19	17	15	13	12	11	10	0	2	5	8
24	22	19	17	15	14	13	12	0	3	6	9
26	24	21	19	17	16	14	13	1	4	7	10
29	27	24	21	19	18	16	15	2	5	8	11
32	29	26	23	21	20	18	16	3	6	9	12
34	31	28	25	23	21	19	18	4	7	10	13
37	34	30	27	25	23	21	19	5	8	11	14
40	36	32	29	26	25	23	21	6	9	12	15
42	39	35	31	28	26	24	23	7	10	13	16
45	41	37	33	30	28	26	24	8	11	14	17
48	43	39	36	32	30	28	26	9	12	15	18
50	46	41	38	34	32	29	27	10	13	16	19
53	48	44	40	36	34	31	29	11	14	17	20
56	51	46	42	38	35	32	30	12	15	18	21
58	53	48	44	40	37	34	32	13	16	19	22
61	55	50	46	42	39	36	33	14	17	20	23
63	58	52	48	44	41	37	35	15	18	21	24
66	60	55	50	45	43	39	37	16	19	22	25
69	63	57	52	47	44	41	38	17	20	23	26
71	65	59	54	49	46	42		18	21	24	27
74	67	61	56	51				19	22	25	28
77	70	63						20	23	26	29
79	72							21	24	27	30
82								22	25	28	
85								23	26	29	

[1] Three pounds of silage equals 1 pound of hay.

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